WORLD SWORDFISH FISHERIES

Volume I.

Executive Overview

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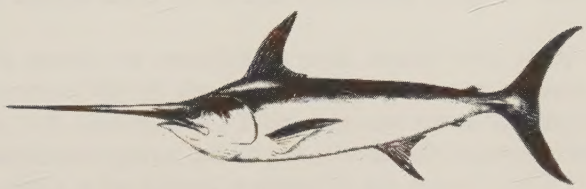
WORLD SWORDFISH FISHERIES

An Analysis of Swordfish Fisheries, Market Trends, and Trade Patterns
Past-Present-Future

Volume I.

Executive Overview



Prepared by
The Office of Science and Technology

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PREFACE

The authors have used statistical data collected by the International Commission for the Conservation of Atlantic Tunas (ICCAT) in Madrid and the Food and Agriculture Organization (FAO) of the United Nations in Rome as the primary sources for their statistical data. Unfortunately, that data does not always match perfectly and some discrepancies exist. In addition, ICCAT and FAO data frequently do not agree with information supplied by various countries. The authors have, for example, press clippings showing landings of swordfish by countries whose landing statistics show "no landings" in both ICCAT and FAO catch statistics. The authors believe that these instances are rare, but they do suggest that readers allow for modest adjustments to figures cited in the report.

This survey depends heavily on unconfirmed press reports from many of the countries involved. The National Marine Fisheries Service (NMFS) does not certify the accuracy of these reports nor does their selection reflect the official view of the U.S. Government. The authors are aware of many missing documents in the NMFS files which might have shed additional light on this subject. The authors encourage individuals or firms with additional information to write to the authors at the address provided in this report.

The *Executive Overview* is designed to give the reader a thumbnail sketch of the most important aspects of world swordfish fishing, markets, and trade. Readers seeking more detailed information should refer to the introductory sections of the different volumes or should review the individual country chapters for detailed information.

ACKNOWLEDGMENTS

The authors wish to express their special appreciation to Richard B. Stone for his interest and support in this project. Mr. Stone has worked tirelessly to support management programs for tunas and billfish for many years and was instrumental in promoting programs to manage and protect swordfish resources on a global basis. He retired from the National Marine Fisheries Service (NMFS) on January 3, 1996, after many years of dedicated service to the Government and the fishing industry.

Special acknowledgment is provided to William E. Martin, Deputy Assistant Secretary for International Affairs in the Office of the Assistant Secretary and Deputy Administrator of NOAA for his personal efforts to conserve and manage international stocks of swordfish in the Atlantic Ocean as United States Commissioner to ICCAT. The work of other U.S. Commissioners at ICCAT, both past and present, and those scientists and managers who assist in this effort are acknowledged. The authors wish to acknowledge the helpful assistance of other international scientists and managers who work within the ICCAT organization or through other international bodies to regulate and manage world-wide resources of swordfish.

Dr. William W. Fox, Jr., Ph.D., Director of the Office of Science and Technology and Frederick H. Beaudry, Chief, Division of International Science and Technology provided invaluable support for this project. Nina Loewinger of the Office of Science and Technology served as the editor for this project and was responsible for the final proofing of the report. The authors wish to thank Brian Hallman in the Office of Marine Conservation at the Department of State for his review and clearance of the final document.

The authors have greatly appreciated the expert assistance from the NMFS and other NOAA colleagues for their many patient hours unselfishly sharing their expertise. The staff of the NMFS Southwest Fisheries Science Center, both at La Jolla and Honolulu, (Norman Bartoo, Christopher Boggs, Robert Dollar, Jeffrey Polovino, Dave Holts, Robert Humphreys, Russel Ito, Donald Kobayashi, Michael Laurs, Richard Parish, Gary Sakagawa, Michael Seki, and others) and the Southeast Fisheries Science Center (Jean Crammer, Albert Jones, Eric Prince, Gerry Scott, and others) patiently navigated the authors through the still evolving intricacies of swordfish biology as well as briefed us on their current research. Staff of the NMFS Office of Protected Resources (Wanda Cain, Tom McIntyre, Barbara Schroeder, Angela Somma, and Dean Wilkinson) provided many valuable insights for the by-catch section. Staff of the Office of Sustainable Fisheries were very helpful. The Highly Migratory Species Division (Michael Bailey, John Kelly, Rebecca Lent, Sarah A. McLaughlin, Ron Rinaldo, and Chris Rogers) provided important guidance on swordfish fisheries and management programs. The International Fisheries Division (Kimberly Blankenbeker, Paul Niemeier, and Dean Swanson) provided background on IATTC and ICCAT and various international negotiations and treaties. Staff of the Office and Technology (Ned Cyr, John Everett, Rachel Husted, Steve Koplin, and Jim Meehan) provided assistance understanding fisheries biology and oceanography as well as obtaining U.S. statistical data. The Office of Industry and Trade (Jerome Erbacher) provided helpful details on trade patterns. The Office of Inter-Governmental and Recreational Fisheries (Richard Schaefer) provided a great deal of information on recreational and historical fishing off Chile. Richard Schaefer, along with Allen Peterson, Director of the Northeast Fisheries Science Center, kindly gave the authors access to their exhaustive collection of books describing the history of recreational and commercial fishing around the world. Vernon Kousky with NOAA's Climate Analysis Center, National Weather Service, kindly provided details on the developing 1997 El Niño and detailed sea surface temperature maps for the eastern Pacific. Staff at National Climatic Data Center of the National Environmental Satellite, Data and Information Service (NESDIS) searched hundreds of satellite images to find one showing the Humboldt Current and upwelling off Peru although the task was difficult because of the lack of high resolution data and persistent cloud coverage, NESDIS did succeed in finding two images for us.

Various individuals from multilateral organizations, academic institutions, and U.S. companies were also extremely helpful to the authors. Assistance offered by the Fisheries Department of the Food and Agriculture Organization has proven crucial in obtaining up to date statistics. The authors are particularly indebted to Adele Crispoldi whose painstaking work compiling often hard to synthesize data is critical to the analysis of world fisheries. Without the work of Adele and her colleagues, the completion of this and previous works by the authors would have been virtually impossible. FAO provides an invaluable service to those of us involved in assessing international fisheries. We are most grateful to Adele for her unfailingly prompt and informative replies to our many queries. Fabio Carocci and Jacek Majkowski, FAO Fisheries Resources Division, published an informative atlas on tuna and billfish which proved helpful in efforts to assess seasonal patterns. Gabriel Rodríguez Marquez, Officer in Charge of the FAO Office, in Montevideo helped organize appointments in Montevideo and provided much useful information on the local fishing industry and foreign activity. Roland Wiefels, Director of INFOPESCA, provided helpful trade data. Martín Hall, Inter-American Tropical Tuna Commission (IATTC), provided insightful data on purse seine by-catches in the eastern Pacific. Michael Hinton, another IATTC researcher, provided an overview of Pacific swordfish research. Matthias Tomczak, Flinders University of South Australia, and J. Stuart Godfrey, Commonwealth Science and Industry Research Organization, kindly permitted the use of some of their informative oceanographic maps. Peter Redmayne, Seafood Leader, provided a wonderful photograph of processing swordfish in San Antonio.

The Office of Science and Technology conducts an active summer intern program to introduce high school and college students to the Federal Government. These students have played an important role in preparing tables and graphics, conducting internet and library searches, preparing bibliographies, and formatting the text for publication. The individuals involved were Kasi Addison, Ebbon Allen, Rita Anderson, Gina Beck, Jennifer Chang, Joe Close, Chinhyen Nguyen, Christine Parker, Debbie Wade, and Nelsinia Wood. Freddy Arocha provided insightful guidance on swordfish biology. Alfonso G. Zavala assisted with the interviews for the both the chapter on Spain and Peru. Julio Serrano played a major role in the Latin American section of the report. Many other individuals have played important roles in the study. Paul Lineberger with Research and Data Systems Corporation (RDC) is responsible for the extensive graphical presentation. He personally prepared over 300 graphics and was tireless in his support of our summer interns who also worked on graphics. The authors also appreciate the work done by Janet Dick and her RDC colleagues in preparing the Division's computers for this project. NMFS contractor Francesa Fontes helped finalized the formatting of the first four chapters of the report on Chile and will participate in the research on the Atlantic coast countries.

NOTES

There is world-wide concern about the use of high-seas driftnets that entangle swordfish and other species. Driftnets were used prior to 1990 by many nations. Unfortunately, driftnets are very effective in harvesting both target and non-target species. As a result of the catch of seabirds, marine mammals, sea turtles, etc. the world community demanded that the use of large, pelagic driftnets be curtailed. The United Nations (UN) responded with a world-wide moratorium on the use of driftnets that went into effect on December 31, 1992. Under the terms of the UN moratorium, use of driftnets longer than 2.5 kilometers (km) on the highseas is prohibited. Driftnets under 2.5 km may, however, be legally used on the highseas. Driftnets over 2.5 km may also be used in national waters. National waters typically include a 200-nautical-mile Exclusive Economic Zone (EEZ) for most countries. In the Mediterranean Sea, however, national waters generally are limited to 12 nautical miles.

Most nations have enacted legislation to comply with the UN moratorium. In some cases it is difficult to document compliance. Driftnets typically consist of 50 meter (m) panels that are linked together to form a net. Individual fishermen can violate the law by linking more than 50-panels together. In many fisheries, especially in many of the lesser developed countries, this is not a problem: vessels simply are too small to handle driftnets that are too long.

In many cases the term "driftnet" applies to the type of fishing gear used, and not to the length of the net. In many parts of Africa, for example, fishermen use a net that drifts with the current and is hauled aboard small canoes in the morning; these canoes would quickly sink if they hauled aboard a driftnet of any significant length. In some parts of Europe "gillnets" are used to fish for Atlantic salmon; these are also small nets used by fishermen using small fishing craft and should not be confused with highseas, pelagic driftnets. Finally, in some parts of French-speaking North Africa the term "*filet maillant*" is used to describe driftnets. The term "*filet maillant*" was originally used to describe the nets used by French albacore fishermen. These nets come in 50-m sections that were linked together to form driftnets of more than 2.5 km when first adopted; the use of these nets is legal, provided they do not extend beyond 2.5 km on the highseas. Thus, in some instances the term "*filet maillant*" still is used and the use of these nets are legal, provided they remain under 2.5 km in length.

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EXECUTIVE OVERVIEW

Thirty-four nations harvested 89,086 metric tons of swordfish in 1995 according to preliminary estimates.[1] The data suggests that world harvests have reached a new world record. The 1995 harvest included 36,645 tons taken in the Atlantic Ocean (41 percent), 7,727 tons harvested in the Mediterranean Sea (9 percent), 13,516 tons caught in the Indian Ocean (15 percent), and 31,198 tons harvested in the Pacific Ocean (35 percent). The preliminary data suggests that Taiwan was the leading producer of swordfish in 1995, with a catch that amounted to 20,051 tons (23 percent of the total world catch). Japan followed with a harvest of 19,776 tons (22 percent), followed by Spain (22 percent), the United States (7 percent), and the Philippines (5 percent). Although catches have declined in certain regions of the world, such as in the Mediterranean Sea, there has been an expansion of swordfish fishing into new areas. The fishing grounds that are likely to be important in the future include the South Atlantic Ocean, the Indian Ocean, and the Southern Pacific Ocean.

I. BIOLOGY

Swordfish, *Xiphias gladius,* are ubiquitous throughout the world's oceans wherever surface waters are warmer than 13 degrees Celsius. The latitudinal range of swordfish extends from approximately 50 degrees North to 45 degrees South. Swordfish is a highly migratory species, distinguished from other billfish by its extremely long and broad bill, its scale-less skin, and lack of teeth in adults of the species. They generally migrate between colder waters in the summer to warm waters in the fall and winter for spawning. Swordfish are sexually dimorphic, with females growing faster and larger than males. Adults can reach a maximum size of 445 centimeters (cm) total length and about 540 kilograms (kg) weight, with size ranges varying in different parts of the world. The largest swordfish are generally found in the southeastern Pacific Ocean.

II. FISHING GROUNDS

The geographic distribution of swordfish varies with seasonal changes in water temperature, but can extend from 50 degrees north latitude to 50 degrees south latitude. Fisheries are conducted in both temperate and tropical waters, but the largest fisheries are primarily in temperate waters. The preferred water temperature for swordfish is 18-22 degrees Centigrade and varies with animal size. Juveniles are found in tropical regions since they prefer warmer water, but adults have a wider temperature tolerance and occupy the full distributional range, spawning in the tropics and feeding in temperate regions. Adult swordfish are found year-round in most parts of the distributional range, except extreme sub-polar latitudes in winter. They concentrate in areas of food abundance, commonly among frontal zones where ocean currents or water masses intersect to create turbulence and sharp gradients of temperature and salinity. Swordfish fishing grounds occur in the regions of these frontal zones.

Atlantic Ocean

In the Atlantic, swordfish range from Canada to Argentina in the west, and from Ireland to South Africa in the east. Swordfish fisheries in the Atlantic Ocean primarily rely on longline gear. Swordfish migratory behavior is not fully understood, but the fish seem to move in what appears to be a series of circular migrational patterns depending upon the season; during summer months they can be found in more northern latitudes in cooler waters. During winter months they are found closer to the Equator where waters are warmer, although Equatorial abundance appears less seasonal. There also appears to be some relatively resident fish in some areas. The countries that have the highest swordfish catches in the North Atlantic Ocean are Spain, the United States, Canada, Portugal and Japan. In the South Atlantic Ocean, Brazil, Japan, Spain, Taiwan and Uruguay dominate the swordfish fisheries. Approximately 41 percent of the world's total swordfish catch came from the Atlantic Ocean in 1995; this amounted to 36,645 tons.[2]

The swordfish stocks of the North Atlantic Ocean are in decline, primarily indicated by rising catch-per-unit-of-effort (CPUE) rates for swordfish fisheries and annually decreasing abundance of older age fish in the population as well as declining average size. North Atlantic swordfish are currently fished at levels above maximum sustainable yield (MSY), which means that the already depleted stocks are likely to continue to decline. Data for South Atlantic swordfish stocks are more limited, although there are several CPUE indices that show declining total stock size. While South Atlantic swordfish stocks may not have declined as far as those in the North Atlantic, current evidence indicates that these stocks are also falling. The transfer of effort from the North Atlantic to the South Atlantic suggests that South Atlantic stocks are coming under increasing fishing pressure. Fortunately, swordfish are a relatively resilient species that could probably be rebuilt through application of more stringent international fisheries management regimes.

Mediterranean Sea

Recent studies suggest that Mediterranean swordfish form a unique stock, separate, but not totally isolated from Atlantic Ocean swordfish stocks. Schools of adult swordfish enter the Mediterranean in April of each year through the Strait of Gibraltar. They swim eastward to waters toward Sicily, usually arriving in May of each year. Spawning occurs mainly in the Strait of Messina and the Tyrrhenian Sea and around the Balearic Islands off the coast of Spain. In the Mediterranean, swordfish spawn during the summer months and the juveniles reach 80 cm in length by the end of their first year. Swordfish are considered by many biologists to be mature by the time they reach five years of age. Swordfish fisheries of the Mediterranean Sea yielded 9 percent of the world's total swordfish catch in 1995 which reflects a continued decline in harvests. The primary nations that target swordfish in the Mediterranean Sea include Italy, Spain, Greece, Algeria, and Morocco. Longlines, nets, traps, harpoons, and other types of gear are used in the Mediterranean swordfish fishery.

Scientific estimates for Mediterranean swordfish stock size are limited, but there are several indicators that the stocks are overfished and declining. The fishery targets 2- to 3-year-old fish, and much of the catch is made up of juvenile swordfish that have never spawned. Swordfish caught in the Mediterranean also tend to be smaller than those caught in the Atlantic Ocean, possible evidence that Mediterranean stocks are even more overfished than those of the Atlantic. In addition to scientific indicators, landings have gone from 20,339 tons in 1988 to an estimated 7,437 tons in 1995 despite efforts of local fishermen to increase landings.

Indian Ocean

Swordfish occur in the Indian Ocean with areas of concentration off the coasts of India, Sri Lanka, Saudi Arabia, the east coast of Africa, and around the Cape of Good Hope. Japanese scientists have also shown areas of concentration between 20 and 40 degrees south latitude, and 60 and 100 degrees

east longitude. Adult swordfish also occur in good concentrations off the southwest coast of Australia. The Indian Ocean contributed 15 percent of the total world catch of swordfish in 1995, nearly double the quantity landed two years earlier. The waters of the western Indian Ocean have grown in importance in recent years and now dominate the fishery. The swordfish grounds in the eastern Indian Ocean have not been as productive in recent years.

Pacific Ocean

There are five frontal zones where swordfish are found in fishable concentrations: 1) the northwestern Pacific, where the warm Kuroshiro Current meets the coastal waters of Japan and Taiwan, and where the Kuroshiro Extension Current meets the Oyashio Current to the north; 2) off southeastern Australia where the warm East Australian Current meets intrusions of the cold Southern West Wind Drift Current; 3) off northern New Zealand, where the warm South Equatorial Current intersects with intrusions of the cold Southern West Wind Drift Current; 4) in the southeastern tropical Pacific, where the warm Equatorial Counter Current intersects with the colder Humboldt Current, and 5) along Baja, California, Mexico, and California, United States, where the cool offshore California current intersects with warmer water from the south.

III. FLEET

World swordfish fishing fleets range from small, wooden canoes used by Ghanaian fishermen to ultramodern foreign longliners used by European and Asian-flag countries. Many of the vessels that fish for swordfish also fish for tuna, depending upon the fishing season and the abundance of fish. For Asian fleets, it is the other way around; Asian vessels primarily target tuna, but also catch swordfish.

Africa and the Middle East

Most African fishing "fleets" in the South Atlantic consist of wooden canoes equipped with a single, outboard motor that is generally in the 45-horsepower range. North African countries use small wooden longliners and other vessels using different types of fishing gear. Arab countries fishing in the Arabian Sea used wooden vessels as well as more modern fiberglass skiffs. The French fishery out of La Réunion is using some very modern longliners to fish for swordfish.

Photo 1.--Chilean artisanal fishermen primarily deploy driftnets. Dennis Weidner

Asia

The Asian distant-water and coastal fleets that catch the vast majority of billfish in the Asia-Pacific region include longline, drift- or gillnet, and harpoon fleets.

Asian-flag longliners primarily target larger tunas (e.g. bigeye, bluefin) which are highly valued on Asian, especially Japanese, *sashimi* (prepared, uncooked fish) markets. Billfish (including swordfish) are caught incidentally in the Asian tuna fisheries. Modern tuna longlining was initially developed in Japan several hundred years ago as a relatively simple method to catch large yellowfin tuna and albacore. This technique is preferred for harvesting tuna and billfish for the *sashimi* market since it is relatively "clean" (meaning little damage is done to the fish carcass during harvesting). High-seas driftnet fishing was widely used by Japanese, Korean, and Taiwan fleets from the mid-80s until the end of 1992. The target species of this fishery were albacore, billfish, squid, and salmon. The distant-water fishery, which employed long monofilament gillnets, had large meshes (18-20 cm) for albacore and billfish, and smaller meshes for squid and salmon (8.5-11.5 cm). As of 1993, large-scale pelagic high-seas driftnet fisheries conducted by Asian distant-water fleets have ceased in accord with the United Nations (UN) moratorium on this fishing method. Harpoons have been traditionally employed by Japanese fishermen, but billfish are no longer taken in this fishery. Harpoon fishing also takes place in Taiwan coastal waters, where between 100-300 tons of swordfish were caught annually between 1990 and 1994, but catch dropped to just 14 tons in 1995. The harpoon fleet operates primarily in the eastern region of Taiwan, from the southern ports of Kaohsiung and Taitung and from the northern port of Keelung. The fishery appears to target a complex of billfishes, with blue and black marlin ranking above swordfish in terms of preference.

Latin America

Latin American commercial, artisanal, and recreational fishermen deploy a wide variety of both artisanal and commercial vessels to target swordfish.

Artisanal: Definitions of artisanal fishermen vary greatly from country to country, complicating any discussions of artisanal fleets in the region. Chile deploys the largest artisanal fleet which is primarily composed of driftnet vessels, mostly 9-18 m in length which are limited to coastal operations. The vessels have ice holds and deliver fresh product. At the peak of the fishery in 1991, about 500 such vessels were active. Small open artisanal boats using harpoons were common in Peru and Chile through the 1970s, but are now rarely used. Mexico deploys a smaller number of vessels, but some are larger than the Chilean driftnet vessels. Mexican officials classify their driftnet vessels as commercial. Ecuador in recent years has deployed a fleet of small artisanal tuna longliners served by motherships, but several in 1996-97 have shifted to

Photo 2.--A Chilean commercial longliner. In 1996, the longline fleet reported excellent harvests of swordfish in offshore grounds. This is one of two Spanish-built longliners owned by a Chilean fishing company. Dennis Weidner

swordfish. A variety of artisanal vessels are also active in the Caribbean.

Commercial: Commercial longliners have been deployed by several countries. The major dedicated swordfish longline fleet is deployed by Chile and includes vessels imported mostly from Spain and Japan. Some of the Chilean longliners are large modern freezer vessels capable of extended operations on offshore grounds. Brazil deploys a larger longline fleet, but is composed mostly of older Japanese vessels conducting multi-species fisheries. Smaller numbers of commercial longliners are active in Costa Rica, Cuba, Ecuador, Trinidad, Uruguay, Venezuela, and other countries. The Costa Rican and Ecuadorean longliners have mostly targeted tuna, but in 1996 reported substantially increased effort on swordfish.

Distant-water: Distant-water fishermen have also deployed vessels off Latin American. The primary distant-water fishing countries taking swordfish off Latin America are Japan, Taiwan, and Spain which operate fleets in both the Atlantic and Pacific. The United States has an important swordfish fishery, but it is primarily conducted in U.S. waters. U.S. longliners working out of Puerto Rico and the U.S. Virgin Islands, however, are active in the Caribbean. Korean longliners are also active, but report minimal swordfish catches. Details are available in the country chapters.

North America

Canada: There were 77 longline fishermen licensed to fish for swordfish in Canada in 1995. This was substantially more than the 53 active longline licenses in 1991. The increased activity is attributed mainly to the closure of groundfish fisheries. In addition, 400 fishermen are eligible for harpoon licenses although only 97 of these fishermen landed fish in 1995.

United States: In the United States the majority of swordfish are caught with longlines. By 1995, there were over 1,900 active and permitted swordfish vessels, mostly longliners, operating in U.S. waters.

Western Europe

The West European swordfish fishing fleet is divided into four types based on the target of the fishery. These include (1) the directed fishery for swordfish using surface longlines, and (2) fleet fishing for swordfish using harpoons. The harpoon fleet requires specialized vessels that allow fishermen to approach the swordfish and then hurl the harpoon at the fish from the bow of the vessel. (3) There are also non-directed fisheries which catch swordfish incidentally to tuna, the primary species. French, Italian, and Irish fishermen harvesting albacore and bluefin tuna once used large, pelagic driftnets. Only small-scale (less than 2.5 km) pelagic driftnets are now being used, although Italian fishermen continued to use large-scale driftnets well past the UN moratorium on the use of these nets. (4) Swordfish are also caught by purse-seines used in association with tuna fisheries; mostly in the Gulf of Guinea off West Africa and in the Indian Ocean by French and Spanish vessels.

IV. SHIPYARDS

Africa and the Middle East

Some African countries have reasonably modern shipyards that can make repairs to steel-hulled vessels. Some of the North African countries have facilities to build or repair ultramodern fishing vessels. Most repairs take place at fishing villages along the beach, along with construction of wooden canoes or small craft. Most Middle Eastern shipyards are rudimentary.

Asia

Asian shipyards are some of the most sophisticated in the world and are able to produce longline vessels ideally suited for fishing highly migratory species, including swordfish. Japanese, Taiwan, and Republic of Korea shipyards, in particular, are especially qualified to build or repair longliners. Other Asian nations are also able to build vessels -- ranging from wooden craft to steel vessels.

Latin America

Several Latin American countries (Argentina, Brazil, Chile, Mexico, and Peru) have shipbuilding industries capable of building large commercial fishing vessels. The two countries most active in the construction of fishing vessels (Chile and Peru) have focused construction on purse seiners for the small pelagic fisheries. The swordfish fishery is a relatively small fishery and the regional shipyards have not focused great attention on this fishery. Most of the domestically constructed vessels currently used for swordfish in Latin America are relatively small vessels, converted from a variety of multi-purpose and dedicated vessels. The swordfish harpoon vessels formerly used were built by local shipwrights. The driftnet vessels were generally converted older vessels, although Chilean yards build small multi-purpose vessels which have been used for driftnetting. Most of the driftnet vessels now in use (Chile and Mexico) are previously owned vessels refitted for driftnet operations. The longliners are mostly imported vessels, primarily from Japan and Spain. Several were acquired through joint ventures. A few shipyards (Chile and Peru) have built small longliners for coastal operations.

North America

Canadian and United States shipyards are able to produce vessels ideally suited for fishing swordfish.

Western Europe

West European shipyards build some of the best ships in the world.

V. FLEET OPERATIONS AND GEAR

Fleet operations

Africa and the Middle East

African fishermen in the Gulf of Guinea head to sea in four- to five-man canoes that carry longlines or gillnets. They travel out to the edge of the Continental Shelf where large pelagic fish come to the surface to feed at night. They set their gear at night and haul the gear aboard in the early morning hours. They return to shore to sell their catch at daybreak.

North African fishermen generally fish closer to shore since they focus their efforts on the migration patterns of swordfish, either before or after spawning. North African fishermen use a variety of gear, including traditional longlines, nets, traps (*madragues*) and other types of gear.

Photo 3.--Mexico currently limits Pacific swordfish fisheries to driftnets, but is considering the authorization of longlines. Dennis Weidner

Asia

Japan, Korea, and Taiwan are the major operators of Asian distant-water longline fleets which target high-value tuna species and incidentally catch billfish species, including swordfish. A typical Asian distant-water longliner measures 150-300 gross registered tons (grt) and 24-46 meters (m) in length, with a crew of 15-30 persons. Fishing trips can range from several months to a year, with catch landed in East and Southeast Asian ports, or transshipped to freezer vessels in ports near main fishing grounds around the world. In addition, smaller longliners from these fleets (less than 100-grt) are active in the central western Pacific. These vessels land their catch in Pacific Island countries such as Palau, the Republic of the Marshall Islands, and the Federated States of Micronesia, for air transshipment to the Japanese *sashimi* market.

Photo 4.--A swordfish harpoon vessel (left) at Terminal Island, California. William B. Folsom, NMFS-NOAA-DOC.

Latin America

Swordfish fisheries vary markedly from many tuna fisheries which employ surface gear targeting large schools. Swordfish do not school and as a result can not be targeted by purse seiners. They are often found at depths well below the surface, especially when feeding at night. As a result, other active methods used for tunas, such as pole and line (live bait) fishing and trolling, are not effective for swordfish. Swordfish fisheries vary significantly in the Atlantic and Pacific, but it is not clear that this is due to inherent differences in fishing grounds or the behavior of the fish. The first fisheries developed as harpoon fisheries and have mostly, but not entirely, been replaced by longline and driftnet fisheries. Off While limited harpoon fishing continues off Latin America (Chile), most of the catch is now taken with driftnets (Mexico and Chile) and longlines (Chile, Uruguay, and the distant-water countries).

Harpooning: Harpoon fishing was reported in Chile during the 19th Century. The fishery seems to have developed later along Peru's northern coast. Fishing operations were quite similar involving crews of usually three men venturing out into the ocean in small, open boats. The fish was marketed domestically, but the appearance of U.S. freezer vessels and freezing plants during the late 1940s caused a short-lived boom off Peru. Harpooning in both countries subsequently declined, but the reasons are not well understood. The authors know of no significant Atlantic-coast harpoon fishing.

Driftnetting: Pacific coast fishermen (Chile and Mexico) initiated driftnet fishing targeting swordfish in the mid-1980s. The Chilean fishermen have deployed smaller nets than the Mexicans, but fishing operations are quite similar. The authors know of no Atlantic-coast driftnet fishery targeting swordfish.

Longlining: Longliners are deployed in the Pacific and Atlantic, including the Caribbean. Fleet operations vary widely. Many countries have deployed large commercial longliners (Chile) while other countries have deployed smaller longliners which may be classified as semi-commercial or artisanal. Other countries (especially Ecuador) have deployed large commercial longliners as well as a fleet of small artisanal "lanchas" serviced by motherships to ensure the production of export-grade product.

North America

Canada: Longlining is currently the primary method of harvesting swordfish in Canada. The fishery was very active in the 1960s when a record 6,888 tons was harvested. The sale of swordfish was banned in 1971 when it was discovered that mercury levels in most swordfish caught off Nova Scotia exceeded Canadian Health and Welfare guidelines. The ban on sales was lifted in 1979 and harvests resumed their steady growth. In 1994, the longline harvest amounted to 1,654 tons out of a total of 1,676 tons landed by Canadian fishermen. This harvest declined to 1,409 tons out of 1,610 tons caught in 1995. In addition, harpooning takes place when the swordfish rest on the surface after feeding. In 1995, Canadian fishermen reported that the thermocline had not fully developed by June-July, and that the fish were close to the surface where they could be harvested using harpoons along the edge of the Scotian Shelf.

United States: In the United States, swordfish fishing began as a harpoon fishery. Today the majority of swordfish are caught with longlines. At least 1,900 commercially-permitted swordfish vessels operated in U.S. waters in 1995. Most of them were longline vessels. Approximately 300 Atlantic permitted vessels catch at least one swordfish each year. Most of these vessels are owned by individual entities. The Pacific fishery is a different story. In California, the harpoon fishery began in the 1900s. In 1980 there were over 1,200 harpoon permits. Of these, fewer than 300 vessels land harpooned swordfish annually. California also has an active driftnet fishery. In 1985, the number of permits peaked at 300 vessels, but declined to 140 by 1994. Longlining in California did not begin until 1993. In 1994 there were 30 swordfish longline vessels based in California. In Hawaii, longlining for tuna began in the early 1900s, but swordfish longlining did not begin until the 1980s. The number of permitted vessels has increased from 37 in 1987 to 164 in 1995. As in the Atlantic, most of the vessels are owned by individual entities.

Photo 5.--The U.S. Pacific swordfish longline fleet is based in Honolulu and primarily fishes north of Hawaii. Dennis Weidner

Western Europe

Swordfish typically are caught on surface longlines when they feed at night, usually within 50 m of the surface. Harpoons are used to spear swordfish as they feed or rest on the surface. Swordfish have also been caught in driftnets. In 1986-87, French scientists developed a new driftnet

called the "*filet maillant.*" The net consisted of 5-m sections linked together forming a panel stretching 2,500 m to 6,000 m in length. Some were allowed to float with the currents while others were towed by two vessels. The UN called for a ban on pelagic driftnets throughout the world effective June 30, 1992. The European Union's (EU) support of the resolution ensured that the use of driftnets in European waters (mostly involving France and Italy) was limited to 2.5 km. Italian fishermen, however, continued to use large-scale driftnets past the UN deadline until international pressure forced the Italian government to impose stiff management controls (although sporadic violations have continued to be observed). Swordfish are also trapped in trawl gear and in traps (*madragues*) set up along the coast of various Mediterranean countries.

Gear

The fishing gear for large pelagics, such as swordfish, is basically the same from one country to another, although variations in size exist. Longlines, for example, are common throughout the world with the differences being the length of the main line; the larger the vessel, the longer the longline. This is true with other nets, such as pelagic driftnets. Bigger vessels with hydraulic equipment can work with larger and longer nets, while four or five men working in small canoes cannot handle larger types of fishing gear. Typical gear used for fishing swordfish throughout the world includes longlines, driftnets or gillnets, harpoons, trap, reel and line, and other gear.

Longliners

Longliners primarily target larger tunas and large billfish which are highly valued on Asian, European, and North American markets. Swordfish are caught incidentally in many tuna fisheries. Tuna longlining was initially developed in Japan several hundred years ago as a relatively simple method to catch large yellowfin tuna and albacore. Many countries, including the United States, now catch most of their swordfish by longlining. This technique is preferred for harvesting tuna and billfish since it is relatively "clean" (meaning little damage is done to the fish carcass during harvesting).

Driftnets

High-seas driftnet fishing was widely used by Asian and west European fishing fleets from the mid-80s until the end of 1992. The target species of this fishery were albacore, billfish, squid, and salmon. The distant-water fishery, which employed long monofilament gillnets, had large meshes (18-20 cm) for albacore and billfish, and smaller meshes for squid and salmon (8.5-11.5 cm). As of 1993, large-scale pelagic high-seas driftnet fisheries conducted by Asian and European distant-water fleets have ceased in accord with the UN moratorium on this fishing method. Small-scale fisheries in Africa and more commercially oriented artisanal fishermen in Latin America (Chile and Mexico) continue to use drift gillnets to harvest pelagic species, but these nets are under the 2.5 km limit imposed by the UN.

Harpoons

Harpoons have been traditionally employed by Asian, European, and North and Latin American fishermen. Some limited harpooning continues, but this labor-intensive method now accounts for a small part of the overall catch. Some of these fisheries have been conducted for centuries. Pre-Colombian Indian civilizations in South America, for example, are known to have taken swordfish.

Traps

Several north African nations employ large traps to catch swordfish as they migrate along the shore in search of food or enroute to their spawning grounds.

VI. CATCH

The world harvest of swordfish grew steadily from around 7,000 tons in 1948 to 37,700 tons in 1970 when the "mercury in swordfish" scare frightened consumers and dampened demand for swordfish. Once the problem was resolved, however, landings resumed their steady growth, peaking at 80,972 tons in 1988, when overfishing in the Mediterranean Sea resulted in lower harvests in the next two years. Lower catches in both the Atlantic Ocean and Mediterranean sea resulted in a harvest of 67,871 tons

in 1991. Several important fishing nations have since shifted their operations into new fishing grounds and the world catch of swordfish reached a record 89,086 tons of swordfish in 1995, according to preliminary FAO estimates.[3]

By ocean

The 1995 harvest included 36,645 tons taken in the Atlantic Ocean (41 percent), 7,727 tons harvested in the Mediterranean Sea (9 percent), 13,516 tons caught in the Indian Ocean (15 percent), and 31,198 tons harvested in the Pacific Ocean (35 percent). Catch statistics show that the harvest of swordfish in the Atlantic Ocean has continued to grow in recent years, despite reports of overfishing. The harvest in the Mediterranean Sea, however, has declined and remains well below previous levels. The harvest in the Indian Ocean has shown growth in recent years while catches in the Pacific Ocean have declined from record highs of 34,624 tons set in 1992.

By country

Preliminary FAO data suggests that Taiwan was the leading producer of swordfish in 1995, with a catch that amounted to 20,051 tons (23 percent of the total world catch). Japan followed with a harvest of 19,776 tons (22 percent), followed by Spain (22 percent), the United States (7 percent), and the Philippines (5 percent). These five countries accounted for 69,567 tons (78 percent) of the total world catch in 1995. The other 29 countries included in FAO catch statistics accounted for the remaining 19,519 tons (22 percent) of the world catch of swordfish in 1995. These countries (listed according to the quantities of swordfish caught) are shown in table 2. Data for Japan reflects their 1994 catches and *not* their 1995 catches.

The authors have also identified a number of countries where fishermen did *not* report catching swordfish between 1993 and 1995, but where swordfish was exported either to the EU or to the United States during those years. These countries included: Antigua-Barbuda, Bahamas, Barbados, Belgium, Belize, China, Colombia, Costa Rica, Côte d'Ivoire, El Salvador, Faroe Islands, Fiji, French Polynesia, Iceland, India, Indonesia, Malaysia, Mauritius, Namibia, Netherlands Antilles, Norway, Panama, Poland, Saint Vincent, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Thailand, Trinidad and Tobago, and the U.S. Pacific Islands. It is likely that these "exports" are transshipments or the result of incidental catches of swordfish that are too small to report.

By geographic region

Africa and the Middle East

The harvest of swordfish by African countries has gradually grown from 548 tons in 1965 to a peak of 3,330 tons in 1988 and then decreased to 2,166 tons in 1994. Harvests in the North Atlantic have been much higher than in the South Atlantic, and harvests in the Mediterranean are considerably higher than the harvest in both the North and South Atlantic.

Asia

The Pacific Ocean yielded 35 percent of the world's total harvest of swordfish in 1995, with landings estimated at 31,198 tons. The northwest Pacific Ocean (14,784 tons or 47 percent) and the western central Pacific (5,417 tons or 17 percent) were the most productive swordfish fishing grounds in 1995. The southwestern Pacific (4,766 tons or 15 percent), the southeastern Pacific (3,283 tons or 11 percent) and eastern central Pacific (2,920 tons or 9 percent) accounted for most of the remainder. The northeastern Pacific Ocean contributed little (only 28 tons) to the overall catch of swordfish in the Pacific Ocean in 1995. The key fishing nations in the Pacific in 1995 included Japan, Taiwan, the Philippines, the United States, and Chile.

Combined swordfish catch data submitted to the FAO by Japan, South Korea, and Taiwan showed a generally increasing trend between 1991 and 1994, with a dramatic increase in 1995. The total catch for these three fleets reached nearly 40,000 tons in 1995, reflecting a big increase in landings

by the fleet from Taiwan. In contrast, swordfish catch by the ROK fleet has gradually decreased, falling from over 1,200 tons in 1980 to just 32 tons in 1994 and 98 tons in 1995. Catch from the Japanese fleet comprised nearly 70 percent of the total until 1994, with Taiwan catch comprising nearly all the remaining landings. In 1995, however, increased Taiwan landings resulted in a fifty/fifty split with the Japanese fleet.

By percentage breakdown, it is evident that the bulk of the Japanese swordfish catch comes from Pacific Ocean coastal and distant-water fisheries, whereas the bulk of the Taiwan catch comes from Indian and Pacific Ocean fisheries. It is notable that Taiwan's swordfish catch from the Indian Ocean has constituted the largest share of its overall landings since 1991. The limited ROK catch tended to come from Atlantic and Pacific fisheries until 1994 when the majority of landings came from the Indian Ocean.

Latin America

Commercial swordfish fisheries off Latin America have developed only recently.

Coastal : Latin American fisheries for swordfish are relatively small and limited primarily to three countries (Brazil, Chile, and Mexico) with smaller fisheries reported in several other countries (Costa Rica, Cuba, Ecuador, Trinidad, Uruguay, and Venezuela, as well as others).

Distant-water: The principal Pacific-coast fishing countries are Japan, Taiwan, and the United States. The principal Atlantic-coast fishing countries are Spain, Italy, and the United States. Three of these countries (Japan, Spain, and Taiwan) are involved in fisheries off Latin America.

Current Latin American fisheries developed in the late-1970s and mid-1980s, and were heavily influenced by Japanese, Spanish, and United States fishing methods and gear. Current catches are primarily reported by three countries (Brazil, Chile, and Mexico). Brazil initiated longline fisheries for swordfish and tunas using leased Japanese vessels and fishing specialists in 1977. Chilean fishermen began a commercial fishery with driftnets and harpoons in the mid-1980s, but some have now deployed longlines. Mexican fishermen initiated joint ventures with Asian longliners in 1980 and their own domestic driftnet fishery in 1986

Photo 6.--The Brazilian swordfish catch is part of a multi-species longline fishery. Some fishermen have recently begun directed swordfish operations. Dennis Weidner.

Latin American countries have reported significant annual catch fluctuations. A variety of fishery and non-fishery factors have caused these fluctuations. Over-fishing appears to be a major factor, but oceanographic events, long-term climatic fluctuations, heavy fishing of fodder

species, market shifts, and other factors are also involved. Some of the regional catch fluctuations are due to the arrangements Latin American countries made with distant-water fishermen as the catch in some countries is included in the domestic catch. Honduras and Panama make flag-of-convenience registrations for foreign-owned (mostly Taiwan) longliners and other fishing vessels, but in most cases the catch is not reported by the flag country.

Latin American fishermen reported their peak catch in 1991, harvesting 10,500 tons. Latin American countries reported a swordfish catch of nearly 8,000t in 1993, more than a 20 percent decline from the 10,100 tons reported in 1992. The Latin American decline is primarily due to a falling Chilean catch. Chilean fishermen through 1995 reported declining yields and a steady reduction in the size of the fish caught. The reasons for the decline are not fully understood, but appear to be due, at least in part, to the heavy effort by both Chilean and distant-water fishermen in the southeastern Pacific.

Only three Latin American countries (Chile, Brazil and Mexico) conduct significant swordfish fisheries. Chile dominates the regional fishery and in recent years has taken more than half of the overall Latin American catch. Brazil and Mexico are the only other Latin American countries which regularly report substantial swordfish catches. The Mexican fishery is a directed fishery (in the Pacific) and the Brazilian fishery is a multi-species fishery also targeting tuna and shark. Several other countries (especially Venezuela and Uruguay) report lesser catches. Two countries (Costa Rica and Ecuador) which had been targeting tuna are reporting much higher swordfish catches in 1996-97. Several other countries (Cuba, Peru, and Trinidad) report small catches or expanded activities within the past few years.

The largest part of the Latin American catch is taken in the southeast Pacific (FAO area 87), primarily because Chile is the major producing country. Latin American countries currently account for about 10-15 percent of the overall world swordfish catch. The 8,000-ton Latin American swordfish catch in 1993 was less than 10 percent of the approximately 85,000 tons caught worldwide. At the peak of the Latin American (Chilean) fishery, the Latin American proportion was closer to 15 percent.

North America

The total harvest of swordfish by all countries in the North Atlantic Ocean (Spain, Canada, Portugal, the United States, France, Japan and Bermuda) amounted to 9,559 tons in 1995. Canadian and U.S. east coast fishermen caught 2,825 tons. The North American fishery for swordfish includes Canada, Greenland, and the United States.

Greenland: Is a minimal player, catching only a small quantity of individual swordfish on an irregular basis.

Canada: Ranks among the world's top ten producers of swordfish with a 1995 harvest of 1,610 tons. The United States ranked as the world's fourth leading producer of swordfish with an estimated catch of 5,916 tons in 1995.

United States: U.S. fishermen caught 1,215 tons in the northwestern Atlantic Ocean, 1,270 tons in the western central Atlantic Ocean, 22 tons in the northeastern Pacific Ocean and 3,409 tons in the southwestern Pacific Ocean, for a total of 5,916 tons in 1995. The value of the total. The U.S. catch of swordfish (Atlantic and Pacific) was worth $37.3 million (exvessel) in 1995. Swordfish catch in the United States has generally increased over time. Recent years have shown a decrease of Atlantic catch from 6,411 tons in 1989 to 4,074 tons in 1994 to 2,485 tons in 1995. This decrease may reflect tougher international management regimes. Pacific swordfish catches follow a similar trend of rapid increase followed by a plateau.

Western Europe

The harvest of swordfish by European-flag vessels has gone from 4,700 tons in 1965 to record highs of 31,500 tons in 1987-88. The harvest then declined to 23,000 tons in 1990-93, and increased to 26,566 tons in 1995.

Spain was the leading European-flag producer of swordfish, landing a total of 19,776 tons in 1995. Spain ranked as the world's third largest producer of swordfish (22 percent of total world landings) from all

fishing areas in 1995. Spain was Western Europe's leading producer of swordfish in 1995 followed by Italy with a harvest of 3,311 tons. Portugal was next with a harvest of 1,997 tons. Greece was Western Europe's fourth leading producer of swordfish in 1995 with landings of 1,403 tons. These four West European countries accounted for 99 percent of the total Western European harvest of swordfish in 1995. Small quantities of swordfish were also landed by Cyprus, Turkey, France, and Malta.

VII. PORTS

There are hundreds of fishing ports throughout the world. Information about important swordfish ports will be included in the individual country sections of this report. In most countries, the swordfish fishery is conducted primarily from a relatively small number of ports: Brazil (Santos), Canada (Halifax), Chile (San Antonio), Italy (Palermo), Japan (Shimizu and Yaizu), Korea (Pusan), Mexico (Ensenada), Taiwan (Kaohsiung), and the United States (Honolulu, New Bedford, the Palm Beach area, and San Juan). Other ports are particularly important to distant-water fishing countries as transshipment ports.

VIII. TRANSSHIPMENTS

Transshipments, in the context of world swordfish fishing, describe the unloading of fresh or frozen swordfish from a fishing vessel for temporary storage and then reloading the fish for shipment to its final destination. In many instances the product is frozen since freezer vessels operate far from their home ports and because fresh swordfish fishing vessels generally operate close to their home ports in order to bring home higher-valued fresh swordfish every few days or weeks. Arranging for transshipping is critical for many distant-water operations as it would be prohibitively expensive for distant-water longliners to take the catch during each trip back to the hone port. The fishermen, however, often have to pay expensive fees when transhipping as well as contend with a variety of sometimes onerous laws and regulations associated with entering a foreign port. The fishermen need to find receptive ports with modern cold stores capable of maintaining high-quality product. Some countries, especially Japan, have acquired a fleet of refrigerated carriers to off-load much of their longline catch at sea. Other fleets, such as Taiwan and Spain's, use ports close to the fishing grounds to transship their fish.

Photo 7.--This Spanish longliner is transshipping its Pacific swordfish catch at the Peruvian port of Ilo. Jose Echandia Zegarra.

Africa and the Middle East

Tuna has long been a commodity that is transshipped through many ports, most notably Abidjan, Freetown, Dakar, and Las Palmas in the Atlantic, and Mombassa in the Indian Ocean. Statistical details on transshipments of

swordfish however, are not always available. Sometimes, import statistics from major importing countries reveal significant shipments of swordfish being made from countries that report little or no harvests of swordfish. For example, the EU reported imports of 1,079 tons of swordfish valued at more than $3 million from South Africa in 1994. South Africa, however, reported landings of only one ton of swordfish in 1994. These shipments doubtless are from a fleet of 90 Japanese longliners that reported a catch of 680 tons of swordfish in South Africa's waters in 1994.

Asia

Asian tuna longliners fish all over the world and transship their catch at many locations. For details on transshipment activities by these vessels, please refer to the individual country studies.

Latin America

Many Latin American countries (Argentina, Brazil, Chile, Ecuador, Colombia, and Mexico). either do not permit transhipment of swordfish through their ports or severely limit it. Such restrictive policies have been established to control or limit foreign distant-water fishing. A few companies (Brazil, Colombia, and Ecuador) do permit foreign companies associated with a local company to land fish for export under conditions that are tantamount to transshipping. Other Latin American countries, in an effort to benefit from substantial expenditures (fees, service contracts, purchase of supplies, personal spending of crew members, etc.), do permit transshipping. The primary Latin American transshipment points are: Port of Spain (Trinidad), St. Maartens (Netherlands Antilles), Montevideo (Uruguay), Ilo (Peru), and Callao (Peru). Fish is also transhipped through Punta Arenas and Arica (Chile), but Chilean authorities do not permit Pacific swordfish to be transhipped. These ports are important to several distant-water countries: Japan (Callao), Spain (Ilo and Montevideo), Taiwan (Port of Spain and Montevideo). Latin American fishermen primarily conduct coastal fisheries and thus do not transship. The only Latin American transshipping known to the authors is conducted by a few Chilean longliners transshipping 50-170 tons of swordfish through Montevideo. For details on transshipment activities at individual Latin American ports, please refer to the appropriate country studies.

North America

Canada: Canadian vessels fish out of Atlantic Canada and currently do not transship swordfish. However, Canadian fishermen are considering establishing operations in South America which would require them to ship their products through non-Canadian ports.

United States: The U.S. does not transship swordfish domestically. U.S. fishermen operating from overseas ports transship their catches through local ports.

Western Europe

Most swordfish caught by European-flag vessels are generally landed at home ports and are sold locally or are immediately processed and exported. Those countries operating far from their home ports, primarily Spain, Portugal, and France, transship their products to European markets through Abidjan in the Ivory Coast, Freetown, Sierra Leone, Dakar, Senegal, and the Canary Islands.

IX. PROCESSING AND PRODUCTS

Swordfish requires only minimal processing in order to meet consumer demands. Hooked fish are killed quickly to minimize struggling that could damage the fish and reduce its market value. The catch is immediately bled, gilled, gutted, and chilled in ice brine. Stomach cavities are usually filled with ice, with the fish itself stored on ice or flash/blast frozen. The fish is then generally landed as chilled or frozen, gilled or gilled-and-gutted, whole fish. Some of the trunks are exported without further processing. This is the general approach in Latin America, except for Chile where substantial quantities of value-added product have been processed. Processing the trunks involves cutting chunks, fillets, steaks, loins, or other value-added product for sale at the retail level. In developing countries small quantities of fish are still prepared in traditional forms. Swordfish is smoked for sale in West Africa.

X. COMPANIES

There are many hundreds of companies that catch, buy, store, wholesale, retail, import, or export swordfish throughout the world. These companies will be examined in the country sections that follow.

XI. DOMESTIC MARKETS

Africa and the Middle East

Swordfish is a valuable export commodity and most of the product is exported. However, some North African countries use some of their catch to sell to local hotels and restaurants that cater to the tourist trade. In some of the West African countries where fishermen cannot land their catch close to ports with freezer facilities, the product may be split into sections and smoked or dried. Senegal smokes swordfish for local consumption as well as for export to neighboring West African countries. The African and Middle Eastern markets for swordfish are very small and are not expected to increase in the near future.

Asia

Billfish are handled, sold, and consumed as types of tuna in Japan. The market is primarily for high-quality billfish, eaten raw in *sashimi* or *sushi*. The product must be fresh, or if frozen, kept at low temperatures (-50 to -60 degrees centigrade) for retention of desired qualities. The Japanese distant-water longliner fleet is the primary source for domestic supplies. Dockside prices in Japan for the major billfish species have exceeded those for major commercial tuna species. There is little or no information available regarding swordfish consumption elsewhere in Asia.

Latin America

Swordfish in Latin America have been utilized since antiquity. Swordfish were targeted by Latin American pre-Colombian civilizations, although the quantities involved are believed to be small. The first known modern fishery was a harpoon fishery conducted in Chile, apparently during the 19th Century. This fishery and a subsequent fishery which developed in Peru was primarily for the domestic market. Catches reached substantial levels. Sustained exports began to the United States in the late 1940s, when freezing was introduced. Exports declined as catches dwindled during the 1960s and 70s. Latin American fishermen (Brazil, Chile, Mexico, and other countries) have since introduced more efficient methods (driftnets and longlines) and have begun targeting export markets, primarily the United States. Currently the species is not widely consumed in Latin America. Few Latin American consumers are familiar with swordfish, both because of the high price and limited local availability. The species does not have the same luxury cachet that is has for U.S. consumers. Swordfish are rarely seen in most Latin American fishery markets. Most of the swordfish available locally is product which did not meet export grade requirements. Extremely small quantities, however, are sold to luxury restaurants, especially restaurants catering to tourists.

North America

Canada: The Canadian market for swordfish is small, but is growing. Information on consumption of swordfish in Canada was not available as this report was being concluded, but Canadian officials report that Canadian consumers are increasingly fond of swordfish and consumption is growing steadily.

United States: In 1995, U.S. processors handled 4,549 tons of fresh or frozen swordfish valued at $53.4 million. Fillets accounted for 2,920 tons valued at $36.5 million while steaks were 1,629 tons worth $16.9 million. The United States imported 4,681 tons of swordfish worth $31.9 million in 1995 and caught 7,278 tons of swordfish (no value currently available).

Western Europe

Western Europe had a population of 441 million in 1992. This included 348 million people in the EU and 93 million in the non-EU countries of Europe. This represents a significant market for any seafood product. In 1993, the European

nations harvested slightly more than 7 million tons of fish and shellfish and 23,213 tons of swordfish. The harvest of swordfish, thus, accounted for about 1 percent of the total West European harvest of fishery products. The EU countries caught 22,876 tons of swordfish while the non-EU countries caught 337 tons of swordfish in 1993. In addition to 23,213 tons landed, West European countries imported 19,668 tons and exported 7,557 tons of swordfish, leaving 35,324 tons of swordfish available for domestic consumption in 1993.

XII. TRADE

Swordfish is an important commodity on world markets, generating in excess of $100 million in export earnings in recent years. Data on world trade in swordfish products became easier to track after 1991 when fresh and frozen swordfish were identified as separate items under universal product codes used to identify different products in international trade; prior to that date swordfish was included under an umbrella category of "other" fish.

Exports

World exports of fresh, chilled and/or frozen swordfish amounted to 13,833 tons worth $78.9 million in 1993. The leading exporters included Spain, Canada, Portugal, and Greece. Exports of fresh or chilled swordfish amounted to 9,460 tons worth $56.1 million as compared with 4,373 tons of frozen swordfish worth $22.8 million.

Africa and the Middle East

Swordfish is a valuable export commodity and is *probably* exported from almost every African and Middle Eastern country that fishes for swordfish on a commercial basis. This includes South Africa, which has a recreational fishery for swordfish (landings amounted to one ton in 1994). However, information on exports from various African countries does not always identify swordfish as a specific export commodity. Some countries may include them under "fresh or chilled" seafoods or sometimes as "tuna and tuna-like fish" or "fresh-frozen" seafoods.

The EU is one of the most important markets for swordfish caught by fishermen in the waters off Africa. EU imports of swordfish from Africa, the Middle East, and the Indian Ocean have increased from 1,725 tons in 1991 to 4,778 tons in 1994. Key suppliers in 1994 included: Mauritius, South Africa, Morocco, Namibia, Réunion, the Ivory Coast, and Sierra Leone. It is noteworthy that South Africa reported only one ton of swordfish landed in 1994 while Sierra Leone reports no harvests of swordfish.

Exports of frozen swordfish accounted for the bulk of shipments (3,739 tons) while exports of fresh swordfish (1,010 tons) were made from countries bordering the major EU markets. Small quantities of frozen fillets were also reported.

The U.S., unlike the EU, is not an important market for African swordfish. The U.S. imported a total of just less than 31 tons of swordfish from *all* African countries between 1980 and 1994. This is even more dramatic when one realizes that 22 tons were imported from South Africa in 1994 alone.

Asia

Although precise data on swordfish exports is not available, data for billfish (including swordfish) indicate that Japan exports only a limited amount of billfish while Korea and Taiwan export significant quantities, primarily to Japan.

Latin America

Latin American countries have directed most of their swordfish exports to the nearby U.S. market. This is in part a reflection of the importance of the strong market for fresh product in the United States and the ease in shipment. The United States is nearby (especially for Mexico) or has direct air service (in the case of Chile and Brazil). It also reflects the fact that American consumers consider swordfish to be one of the premier fish species while Japanese consumers, in one of the two important alternative markets, appear to prefer some tunas

which have red flesh in many preparations. Europe (especially Spain) is another potential market, but prices are more attractive in the U.S. market. While Latin American fishermen may only catch about 10 percent of the world total, they play a much more important role in the U.S. market. Latin American suppliers (primarily Chile) supplied over 80 percent of U.S. imports (1990-91). Even after the Chilean fishery declined, the country still supplied about half of all U.S. imports in 1995.

North America

Canada: Exports of swordfish from Canada have grown sharply since 1980 when 192 tons of swordfish valued at $0.9 million were shipped across the Canadian-U.S. border to markets in Boston, New York, and elsewhere. U.S. import statistics show that imports of fresh swordfish from Canada amounted to 1,258 tons worth $12.1 million in 1995.

Canada exports very small quantities of swordfish to markets outside of the United States. Canada did, however, export four tons of fresh dressed swordfish worth $73 thousand to the United Kingdom in 1991. Exports to the UK increased to two tons of fresh dressed fish worth $38 thousand and three tons of frozen swordfish worth $48 thousand in 1992. There were no exports reported for 1993. The EU market for Canadian swordfish is not considered important and is likely to remain so, unless there are problems associated with shipping Canadian products into the U.S. market.

United States: The U.S. exports very minor quantities of swordfish.

Western Europe

There is significant trade in swordfish within Western Europe. Most non-EU countries export their catches (small incidental harvests) to EU countries. Within the EU there is also a considerable amount of intra-EU exports, with some countries importing whole swordfish for processing and then re-exporting the product; the Netherlands has a reputation for serving as a broker in fishery products and not as a primary consumer. However, some important consuming nations, such as Spain, will export swordfish to other EU countries and even to distant markets.

Imports

World imports of fresh, chilled and/or frozen swordfish amounted to 44,730 tons worth $203 million in 1993. Leading importers of swordfish included Japan, the United States, Italy, and Spain in 1993. Imports of fresh or chilled swordfish amounted to 10,994 tons worth $81.3 million in 1993. This compares with imports of 33,736 tons of frozen swordfish worth $121.7 million in 1993.

Africa and the Middle East

Very few African nations are thought to import swordfish. The exceptions are Mauritius and South Africa, which have imported swordfish from Japan in recent years. In 1992, for example, these two countries imported 202 tons worth $687,000 from Japan. Japan also exported small quantities of swordfish to the Canary Islands, which technically should be listed as an export to the EU. The Ivory Coast is thought to import small quantities of smoked swordfish from Senegal, but details on this trade are not available. Other African states also purchase small quantities of smoked swordfish from artisanal fishermen from time to time, but these exports are not documented.

Asia

Available information indicates Japan imports a great deal of billfish (including swordfish). Korea and Taiwan do not have data on billfish or swordfish imports, but there is little indication that these countries import a significant amount of swordfish.

Latin America

Latin American countries do not import significant quantities of swordfish. Some Latin American countries do import minimal quantities, mostly from Chile, to supply luxury markets.

mostly from Chile, to supply luxury markets. Uruguay in 1995-96 reported more substantial imports, but this was probably product being transshipped through Uruguay by Chilean longliners operating in the Atlantic.

North America

Canada: There are no imports of swordfish into Canada.

United States: Canada and Latin American countries are the major suppliers. The United States imported 5,139 tons of swordfish valued at $32.9 million in 1996 from 29 different countries. The principal suppliers in 1996 included: Chile, Costa Rica, Brazil, Canada, and Uruguay. Shipments from Canada dropped sharply and as a result Chile emerged as the leading supplier. Costa Rica is not normally a major supplier, but the country has made considerable progress in developing a longline fishery which in 1996 significantly targeted swordfish. Brazil and Uruguay have for years been important suppliers. Some Brazilian fishermen are reportedly shifting away from Japanese multi-species longlining to U.S.-style monofilament operations specifically targeting swordfish. Uruguayan fishermen are giving increasing attention to swordfish longlining.

Western Europe

The EU is the most important market for swordfish in Western Europe with imports of 19,155 tons of swordfish in 1994. These imports included 8,028 tons of intra-EU trade and 11,127 tons from non-EU countries. These imports included 4,574 tons of fresh swordfish, 13,696 tons of frozen (whole) swordfish, 708 tons of swordfish fillets and 177 tons of swordfish meat.

Most of the EU's imports of swordfish from non-EU countries in 1994 came from the Indian Ocean (3,041 tons), East Asia (2,184 tons), Central America and the Caribbean (1,651 tons), Southeast Asia (1,644 tons), and West Africa (973 tons).

XIII. GOVERNMENT POLICIES

Africa and the Middle East

A few African states are members of the International Commission for the Conservation of Atlantic Tunas (ICCAT) and have adopted the recommendations made by that body. Several nations have imposed their own domestic regulations governing the harvest of swordfish, or limiting the use of certain types of fishing gear, vessels, or vessel operations.

Asia

Japan and the Republic of Korea are members of ICCAT and abide by that body's management regulations. The authors are not aware of any domestic regulations governing swordfish catch by Asian fleets.

Latin America

Government fishing policies vary widely in Latin America from country to country. Few countries have detailed regulations covering swordfish, as it is taken in only small quantities by most countries. Swordfish is often covered by more general regulations on highly-migratory oceanic pelagics. The current commercial fishery is relatively new and some countries (e.g. Mexico) are just beginning to formulate specific swordfish management policies.

Atlantic: Atlantic coast countries (Cuba, Brazil, Uruguay, and Venezuela) have generally followed ICCAT regulatory guidelines, although two of the most important countries (Brazil and Uruguay) have expressed reservations over ICCAT quota restrictions
which could affect the expansion of their domestic fishery. Mexico is not a member of ICCAT, but has expressed an interest in joining. Mexico in 1997 issued new regulations governing the longline fishery which included an observer program and by-catch limits.

Pacific: There is no agreed regulatory program for eastern Pacific swordfish As a result, regulations vary widely. One country (Chile) has developed a detailed management system because of the decline in the fishery since 1991. The Chilean management plan primarily involves a ban on new entrants and various gear and area restrictions to restrict effort. The Chilean program was expanded in 1997 when a size limit was introduced Regulations elsewhere vary. Peruvian regulations have made licenses so expensive that they have discouraged development of the fishery. Colombian and Ecuadorean regulations put few restrictions on domestic fishing.

North America

Canada: The Department of Fisheries and Oceans (DFO) annual management plans for swordfish are based on the Canadian quota, which since the 1995 season has been established by the ICCAT and from consultations with Canadian fishermen and exporters through the Atlantic Large Pelagics Advisory Committee. The DFO plan controls fishing effort through restrictions on the issuance of fishing licenses. Conservation controls are implemented through quotas and size limitations.

United States: The National Oceanic and Atmospheric Administration (NOAA) is responsible for living marine resources. The National Marine Fisheries Service (NMFS), an agency of NOAA, must follow a number of regulations which deal with the management of natural resources. These laws include the Magnuson-Stevens Fishery Conservation and Management Act, the Endangered Species Act, and the Atlantic Tunas Convention Act (ACTA). The United States is also a member of many international groups which are concerned with the conservation of tuna and tuna-like species such as swordfish. These groups include ICCAT, the Inter-American Tropical Tuna Commission (IATTC), and the Interim Scientific Committee for Tuna and Tuna-like species (ISC). NMFS implemented the fishery management plan (FMP) for Atlantic swordfish in 1985. This arranged for 1) variable season closures and annual adjustments of the closures to achieve optimum yield, 2) procedures for evaluating and restricting specific fishing practices in the future, and 3) statistical reporting and procedures for altering data reporting. A proposed amendment to the FMP will establish eligibility criteria for participation in the fishery based on historical participation. On June 4, 1996, in response to ICCAT recommendations, NMFS issued a rule that 1) reduced the total allowable catch by 359 tons to 3,500 tons whole weight, 2) decreased the minimum size to 73 cm cleithrum to caudal keel measure, 3) eliminated the trip allowance of undersized swordfish, 4) made reporting requirements consistent with the logbook program, and 5) changed the fishing seasons to June 1 through November 30 and December 1 through May 31. California regulates swordfish fishing in its own waters. In 1973, harpoons were declared the only legal commercial fishing gear. In 1980, driftnets were allowed on a limited entry basis. In 1994, longlining was allowed. In 1987, the Western Pacific Regional Fishery Management Council (WPRFMC) began requiring pelagic fishers to obtain a fishing permit for longlining and to obtain a limited entry permit for longline gear holders. In 1991, the WPRFMC placed a moratorium on the entry of longlining vessels into the fishery and prohibited areas for longlining. In 1994, a mandatory observer program was placed on longliners due to concern for sea turtles.

Western Europe

There is no Western European body that establishes policies for the conservation and management of swordfish. ICCAT is the one important body that promulgates and enforces regulations for the conservation of swordfish in the Atlantic Ocean and Mediterranean Sea. These regulations are accepted by ICCAT members. ICCAT, thus, serves as the administrator for swordfish management and conservation policies that affect Western European countries that belong to the organization.

The General Fisheries Council for the Mediterranean (GFCM) also plays a role in the fisheries of the Mediterranean and encourages its members to observe various management efforts, such as those regimes adopted by the UN. GFCM also hosts various scientific meetings, frequently in cooperation with ICCAT.

ICCAT first established recommendations in July 1991, to protect swordfish resources in the North Atlantic. In 1992, additional recommendations were made to maintain catch levels at "recent levels." There are no ICCAT regulations controlling the harvest of swordfish in the Mediterranean. The EU enacted several regulations protecting swordfish in the Mediterranean in 1995.

XIV. RESEARCH

Africa and the Middle East

Most African and Middle Eastern fishery research institutions lack the financial resources to do studies on swordfish. Tuna, by and large, is the main source of export revenue for most of these countries and swordfish is not considered as vital a commodity. Nevertheless, some African countries do an excellent job of maintaining statistical databases on swordfish landings. The French-speaking nations of Africa also maintain close links with IFREMER and French scientists frequently work with local scientists to undertake specific studies of swordfish.

Some of the North African states are undertaking research efforts to better understand the swordfish in the Mediterranean. Algeria, Morocco, and Tunisia are especially active in this regard.

Asia

Due to the commercial importance of tuna and tuna-like species (such as swordfish), Japan, Korea, and Taiwan all are engaged in considerable research on these species.

Latin America

Several Latin American countries are conducting research on tuna and other large pelagics such as swordfish. The research institutes in the region have focused primarily on tuna as several of the countries have commercial tuna fisheries (Brazil, Ecuador, Mexico, and Venezuela) of considerable importance. Very little of the research in the region, however, has focussed specifically on swordfish, reflecting the minor importance of this fishery in most countries. The only major swordfish research program in Latin America is underway in Chile and is being conducted by the Instituto de Fomento Pesquero (IFOP) and associated universities. Brazil's Instituto de Pesca and Venezuela's Instituto Oceanografico have small, but valuable programs.

North America

Canada: The DFO conducted a swordfish longlining cruise in 1992 to collect data on aging and growth studies, fecundity, morphometrics, and stomach contents. Further, collaborative studies were conducted with the Royal Ontario Museum in 1992. The DFO and the Nova Scotia Swordfishermen's Association participated in a joint pilot tagging program during the summer of 1994. The study was coordinated by DFO's St. Andrews Biological Station at St. Andrews, New Brunswick. The purpose of the study was to tag undersized fish to obtain information on migration patterns, seasonal distribution, and stock structures as well as growth and survival rates.

United States: Current research on both coasts include 1) studies on whether Atlantic, Pacific, and Mediterranean stocks consist of one stock, 2) tagging studies to show migratory routes and growth rates, 3) analyses on the percent of small swordfish discarded dead, 4) sex-ratio studies, 5) ageing studies, 6) a reproductive study, 7) spatial dynamic studies, and 8) trophic dynamic studies.

Western Europe

Participating institutions on swordfish research have included: the IFREMER in France; the Department of Zoology of the University of Athens, the Institute of Marine Biology of Crete of Iraklion and the National Center for Marine Research in Greece; AQUASTUDI of Messina, the Department of Animal Production of the University of Bari, the Laboratory of Marine Biology of Bari, and the Institute of Zoology of the University of Genova in Italy, the Spanish Institute of Oceanography of Santander and the Laboratory of Ichthyology of the University of Girona in Spain.

XV. BY-CATCH

Swordfish fishermen experience interactions with a wide variety of marine species. Very limited data, however, exists on these extent of these interactions. Some studies have been conducted by United States and Australian researchers, but in most other countries only anecdotal accounts are available. Environmentalists are currently most concerned about longline by-catch as pelagic driftnets are now banned. Many countries, however, continue to use smaller driftnets in coastal waters and various reports suggest that fishermen in some countries continue to use large driftnets.

Fish: Longline and driftnet by-catch of fish species includes dolphinfish/dorado (*Dorade tropicale)*, wahoo (*Thazard batard)*, barracuda (*Sphyraenidae)*, moonfish (*Vomer declivitrons)*, pomfrets (*Bramidae)*, and sharks. Environmentalists are especially concerned about rising pressure on many shark species.

Turtles: Swordfish and tuna longlining as well as coastal driftnetting does result in turtle mortalities. Available data is limited, but given the fishing effort involved, even a small mortality could have a major impact on some populations which have declined to extremely low levels. This may be an especially serious problem in specific areas, such as off turtle nesting beaches and other areas where turtles congregate.

Cetaceans: Available evidence suggests that cetacean by-catches in longline fisheries occur, but are not massive. The fishermen in many areas, however, are very critical of problems associated with killer and false killer whales which learn to feed on the catch. Reports from fishermen describe various selective feeding habits.

Pinnipeds: Very little is known about pinniped interactions. The few available studies do not suggest that there are large mortalities, but in some cases the data were from areas without substantial pinniped populations.

Photo 8.--Environmentalists are concerned about the possible impact of expanding longline fisheries on turtles. Nestings of these olive Ridleys are increasing, but nestings of some other species are declining. Dennis Weidner

Sea birds: Many different sea bird species can be caught by longline fishing gear used to catch highly migratory species, such as swordfish. This gear also catches albatross, petrels, shearwaters, and penguins. These birds tend to follow fishing vessels to feed on food scraps overboard or to feed on the fish caught by, and the bait used in, longlining fisheries. When attempting to secure said fish or bait, the birds can become entangled in the fishing gear and drown. In longline fishing, birds dive after bait while the line is being set and some become hooked and drown as the longline sinks.

Africa and the Middle East

The by-catch of most native fishing, conducted with longlines or gillnets, includes any carnivorous species of fish that feeds at night in deep water or close to the surface along the Continental Shelf. This mostly includes sharks and tunas. In the North African trap fisheries, the fishermen harvest tunas, mackerels and other species.

Asia

Attention in recent years has focused on by-catch of sea turtles and sea birds in fisheries conducted by Asian distant-water longlining fleets. Little or no information is available on sea turtle by-catch by these fleets, but some work has been done in measuring and trying to prevent sea bird By-catch by Japanese longliners operating in the Australian EEZ.

Concern in Australia has centered on the by-catch of albatross in this fishery, since albatross are long-lived, late to mature, and are slow breeders that are particularly vulnerable to depletion if the mortality rate increases for any reason. It has been estimated that 44,000 albatross were killed by Japanese longliners fishing in the Southern Ocean during 1989. At that time, approximately 107 million hooks were set in the Japanese tuna longlining operation, but this number has been reduced in subsequent years resulting in reduced seabird by-catch, reportedly decreasing as much as 88 percent in 1990.

Latin America

Very limited information is available on the by-catches associated with Latin American swordfish fisheries. Data collection on the fisheries involved is limited and that on by-catch almost nonexistent. The fishermen are generally reluctant to discuss by-catch because of trade actions taken by importing countries as a result of by-catch issues.

There is evidence, although limited, that turtle interactions off Latin America may be of some importance. Turtles nest extensively in Mexico and to a lesser extent in Venezuela, Costa Rica, and countries in the region. Some of the Latin American fisheries (harpoon and driftnets) have been concentrated in coastal waters, but not in areas of high turtle abundance (central Chile and northern western Mexico). The migratory track of many species, however, runs through the EEZs of almost all the major swordfish fishing countries. Several countries (Costa Rica, Ecuador, and Chile) are expanding offshore longline fisheries which may result in expanded by-catches. The authors know of few Latin American assessments of turtle by-catches. Fishermen and companies in the area report that by-catch levels are minimal. Environmentalists are not convinced. Some U.S. and Australian work provides possible insights into the extent of such by-catches.

Cetacean interactions with swordfish fisheries off Latin America are not well understood. While the tuna purse seine fishery has been studied, very little information is available on the impact of driftnet and longline fisheries. The Mexican swordfish driftnet fishery off the Baja is similar to the southern California fishery which has been studied. The authors know, however, of no Latin America study assessing by-catch of tuna/swordfish driftnet or longline fisheries. There are known to be interactions and U.S. and Australian studies offer some insights into the possible extent of the interactions. The fishermen generally report minimal interactions with the exception of longline fishermen who report that whole sets are sometimes destroyed by killer whales who follow the boats and other species. The whales usually avoid the head where the fish is hooked and often will only eat the viscera, but the whales in different areas seem to have quite different preferences. Vessel captains have developed strategies for groups of vessels to draw the whales away from grounds to be targeted. In other instances, the fishermen have simply had to withdraw from grounds that were yielding good catches. This appears to be more of a problem in the South Atlantic (Brazil and Uruguay) than in the southeastern Pacific. Specific reports are included in the individual company chapters.

Little information is also available on pinniped interactions. The authors know of no actual studies, but again some U.S. and Australian reports on other

grounds offer possible insights into the dimension of the problem. They do not appear to be large, but even limited mortalities could affect small populations on islands off Mexico, Ecuador, and Chile. Latin American fishermen (Chilean and Ecuadorean) in recent years have intensified fishing effort on grounds around some of these islands. The impact on pinniped stocks is largely unknown. The abundance of pinnipeds and the islands involved is reviewed in the individual country chapters.

North America

Canada: Sharks, tuna, and billfish are sometimes caught in swordfish longlines.

United States: Sharks, tuna, and billfish are often caught in swordfish longlining operations. Swordfish is caught on shark and tuna longlines as well as in squid trawls. Marine mammals, sea turtles, and seabirds are sometimes caught in swordfishing gear. Some studies of longline and driftnet fisheries have been conducted to assess the extent of these interactions. Unlike the other gears, there is no incidental catch in the harpoon fishery.

Western Europe

The by-catch of European-flag fishing, mainly conducted with longlines, includes any carnivorous species of fish that feeds at night in deep water or close to the surface. This mostly includes sharks and tunas. In some of the gillnet or trap fisheries, the fishermen harvest tunas, mackerels and other species.

XVI. INTERNATIONAL RELATIONS

There are a number of multilateral organizations that deal directly or indirectly with issues concerning swordfish. ICCAT is one such organization. ICCAT deals with scientific management issues in the Atlantic Ocean and Mediterranean Sea.

Africa and the Middle East

African fisheries range from artisanal, canoe-based to those employing modern highseas vessels equipped with the latest in fisheries technology. Fishing grounds also vary, from the rich grounds off Mauritania to the relatively nutrient-poor waters along the narrow Continental Shelf found off the Ivory Coast. The waters off Africa have attracted foreign fishermen for many generations, especially from former colonial powers. Beginning in the late 1950s and early 1960s, African nations gained independence and began excluding their former colonial owners from their national waters. This process was accelerated in the 1970s as many nations around the world extended their EEZs to 200 miles. Some former colonial powers recognized the changes sweeping the continent and negotiated bilateral fishery agreements with some of their former colonies.

In 1977, The European Community (now the EU) began negotiating international fishery agreements with various African states on behalf of their member states. The first agreements simply replaced existing bilateral agreements reached between EC member states and their former colonies or they were agreements that previously existed. Agreements with Mauritania, Guinea (Bissau) and Guinea (Conakry) and Senegal were among the first agreements negotiated in West Africa. The most important agreement came in 1988 when the EU signed an agreement with Morocco allowing nearly 800 EC vessels access to Morocco's territorial waters. The EU has gradually increased the number of international fishery agreements; by 1993, a total of 19 agreements, valued at nearly $775 million, had been signed with African and Indian Ocean countries. African states also negotiated bilateral fishery agreements with Japan, Taiwan, and the Republic of Korea in the 1970s and

1980s. Asian fishermen were especially attracted to tuna and billfish found in the eastern and southern Atlantic Ocean.

There are very few opportunities remaining among the Mediterranean countries to develop cooperative programs to fish for swordfish because swordfish stocks are overfished. The only realistic opportunities are for all the Mediterranean countries to cooperate with ICCAT in its efforts to conserve swordfish stocks in the Mediterranean by reducing harvests.

Opportunities to establish cooperative agreements in the North Atlantic exist as one travels further down the coast of the African continent. The EU already has a network of access agreements with many West African nations (see the Western European section which details these agreements) and it is very possible that EU negotiators will include swordfish among the species they seek to fish in future revisions of existing accords. Almost all of these accords already include tuna. It is likely that swordfish caught as by-catch are transshipped to Europe through Dakar, Freetown, and/or Las Palmas.

The development of swordfish fishing in the South Atlantic offers the greatest possibilities. EU negotiators, prompted by Spanish longline fishermen, are likely to seek to include swordfish among access agreements that are due to be renegotiated in the next few years. Angola could be a target since 815 tons were harvested in 1986 by Angolan fishermen. Spanish longliners have considerable experience in the Gulf of Guinea and presumably they would enjoy access to Angola's waters. The EU has been very successful in supporting their fishermen by opening fishing rights to distant waters through access agreements.

Asia

Since the distant-water longliner industry is of great importance to Asian fishing fleets, access agreements have been negotiated with a great number of foreign countries. These negotiations took on added importance with the declaration of 200-mile EEZs by a great number of coastal countries around the world.

Latin America

There is no international body responsible for swordfish management in the Pacific, but ICCAT has implemented management schemes in both the North and South Atlantic.

Pacific: There is no international body managing swordfish in the Pacific. Thus the swordfish fisheries currently conducted in the southeastern Pacific off Latin America are subject to no regulation outside the 200-mile zones. The IATTC, however, has sponsored some research on the species. Pacific countries are concerned about the status of Pacific stocks and two international symposia have been held to discuss the status of scientific research available on Pacific swordfish.

Atlantic: The international organization which manages Atlantic swordfish is ICCAT. Members of ICCAT expressed increasing concern with the status of swordfish stocks in the 1980s. The Latin American members (Brazil, Cuba, Uruguay, and Venezuela) and observers (Mexico), however, played a relatively limited role in the discussions on swordfish and at many ICCAT meetings did not even attend. Increased fishing mortality rates over the past decade and concern over the status of the swordfish resource in the Atlantic lead ICCAT to recommend reducing catch levels below the 1988 level, as well as reducing the take of juveniles. ICCAT is particularly concerned about stocks in the south Atlantic where catches have expanded sharply in recent years and has recommended that the fisheries there be closely monitored. The first ICCAT regulations on swordfish (agreed upon at the 1990 Commission meeting) were put into effect during July 1991. The Latin American ICCAT members through 1995 continued to play a limited role in the ICCAT discussions on swordfish. ICCAT members have attempted to take the needs of the Latin American-member countries into account by making special exemptions for countries with small fisheries. As a result of growing distant-water effort, the Latin American countries in recent years have shown greater interest in ICCAT deliberations, especially possible quota restrictions.

Mexico has expressed a possible interest in joining ICCAT.

Several distant-water countries conduct fisheries off Latin America which either target swordfish or take some swordfish incidentally. Japanese, Korean, and Taiwan and Spanish fleets are most active. Japanese activity is still extensive in both the Atlantic and Pacific, has been declining in recent years. Taiwan activity off Latin America is focused on the Atlantic, but involves both Taiwan and various flag-of-convenience vessels. Taiwan in recent years has shifted its South Atlantic focus (southern Brazil and Uruguay) from swordfish to albacore tuna. Korea reports minimal swordfish catches off Latin America. The Spanish concentrate primarily on the Atlantic coast off South America (southern Brazil and Uruguay), but have deployed vessels in the Pacific (Chile and Peru), but the number has varied widely from year to year. Notably there have been almost no seizures of these vessels by Latin American countries for illegal fishing. Fishermen from the individual countries, however, report extensive foreign activity.

The foreign longline fisheries have given rise to a variety of bilateral contacts with the Latin American governments. In most cases it is the individual foreign company or in some cases trade associations which have dealt with Latin American governments. The authors know of no umbrella government-to-government agreement covering the foreign activity. Many Latin American coastal countries (Argentina, Colombia, Ecuador, and Peru) have developed fishing regimes requiring foreign fishermen to form association agreements with local companies rather than just purchasing fishing licenses.[4] Some countries (Brazil, Chile, Mexico, and Venezuela) have regulatory regimes that basically exclude foreign fishermen. Some countries (Chile,[5] Peru, Trinidad, and Uruguay) have taken advantage of the foreign activity to generate substantial income from supporting foreign vessels.

North America

Canada: Canada works to promote the conservation and management of swordfish through ICCAT.

United States: The U.S. is a member of IATTC, ICCAT, Interim Scientific Committee for Tuna and Tuna-like Species, and the North Pacific Marine Science Organization (PICES).

Western Europe

Most West European countries do not fish for swordfish and thus do not belong to ICCAT. The EU is currently seeking membership as a representative of all EU states. EU states that are ICCAT members include France, Portugal, Spain, and the United Kingdom (with its dependent territory of Bermuda). Iceland and Sweden have attended as observers.

XVII. JOINT VENTURES

Africa and the Middle East

European nations are not actively seeking opportunities to establish joint venture swordfish fishing operations with North or West African states. Instead, they are relying on the EU to negotiate access agreements to local waters. Most African countries would welcome an opportunity to participate in a joint venture operation since the South Atlantic is one of the few remaining areas where swordfish stocks are relatively healthy. Despite the current impasse, it is logical to expect that some joint venture operations focusing on swordfish will be created before the turn of the century.

Asia

Little information is available regarding joint venture operations by Asian longliners in foreign waters. More frequently, access arrangements are negotiated for Japanese, Korean, and Taiwan longliners which allow them to operate in foreign waters.

Latin America

There is a great deal of foreign commercial activity in Latin American involving fisheries. Actual joint ventures requiring equity participation, however, are limited. The general practice in most countries (Brazil, Colombia, Ecuador, and Peru) is for a local company to "lease" a foreign fishing vessel. In some cases the company is an important local fishing company, but in other instances dummy companies are involved. In most cases the local company has almost nothing to do with fishing operations and the arrangements are simply a form of licensing the foreign vessels with a requirement that the catch be landed and delivered to a local company. In most instances, the technology transfer has been limited as the captains and other highly skilled positions are foreigners. The Japanese began such operations in Brazil during the 1970s and while local equity joint ventures have been set up, most Brazilian tuna/swordfish longline captains are still Japanese. Readers are referred to the individual country sections for further information on joint venture activities in Latin America.

North America

Canada: A number of Canadian fishermen expressed an interest in forming joint venture fisheries with Bermudians who were interested in developing their offshore swordfish fisheries. This interest, however, did not lead to any permanent ties. In 1996, Canadian fishermen began exploring the possibility of establishing a joint venture swordfish fishing operation based in Uruguay.

United States: There are no joint venture fishing operations for swordfish in the United States. However, U.S. fishermen have fished for swordfish out of foreign ports. These operations are examined in the Latin American volumes.

Photo 9.--Taiwan owners have registered many vessels under foreign flags, especially the Panamanian flag. This Panamanian-flag trawler is calling at a port in New Zealand. Dennis Weidner

Western Europe

The EU encourages its member states to enter into joint venture arrangements with foreign companies. The results, however, have not been particularly successful when applied specifically to swordfish. Some EU countries, however, have been very aggressive in establishing overseas joint ventures. Spain, in particular, has over 100 joint ventures around the world.

XVIII. FUTURE TRENDS

Africa and the Middle East

Swordfish harvests by African nations are expected to grow slowly, with most of the growth coming from North Africa's fisheries in the hard-pressed Mediterranean fisheries. The use of new gear is expected to harvest more swordfish as they migrate to their spawning grounds off Italy and Spain and will contribute to lower catches among some European countries. Artisanal canoe fishermen in West and Southwest Africa are not expected to expand their harvests significantly in the next few years. Growth of fisheries in East Africa also appears limited by poor economic conditions. It is likely that Omani fishermen may negotiate access agreements with either Spanish or Asian-flag longliners to fish for tuna in Omani waters beginning in the mid-1990s.

The future will be controlled by European fishermen who may seek to include rights to fish for swordfish in access agreements with many of the African nations where the EU already has working relationships. French fishermen have found fishing for swordfish in the Indian Ocean to be increasingly profitable and the number of vessels heading for La Réunion has grown in recent years; some of these vessels are ultramodern and capable of holding their catch at very low temperatures for months at a time. The high level of exports of swordfish through South African ports is also deserving of careful consideration. It is highly likely that the swordfish being caught by Asian-flag longliners off the southern coast of Africa are migrating between the Indian Ocean and the South Atlantic Ocean.

Asia

Since swordfish is a by-catch in most commercially significant Asian longlining fisheries, it is difficult to predict future trends for this species. The remarkable increase in Taiwan landings during the 1990s, particularly in the Indian Ocean, should be highlighted as the most significant current trend. Catch trends for Japan are generally stagnant, while Korean catch is becoming increasingly insignificant.

Latin America

Latin American fishermen are aware of the tremendous markets for swordfish in the U.S. and EU and export most of their catch. Many countries would like to expand such shipments. A description of the outlook for individual countries is provided in the country reports prepared in volume IV of this study.

Several countries in the region have significantly increased their potential to harvest swordfish in recent years. Virtually all tuna and swordfish longline fishing through the 1980s was conducted primarily by foreign fishermen through a variety of association arrangements. There has since been an impressive expansion of local fishing effort and greatly improved technical competence.

Driftnets: Local fishermen (primarily Chilean and Mexican) initiated driftnet fisheries in the mid-1980s. These fisheries have produced substantial quantities of swordfish, but local officials and the fishermen do not see any potential for expanded driftnet fisheries.

Longline: Even more impressive has been the expanding longline fishing. There was virtually no Latin American commercial longlining in the early 1980s. The longlining that did take place relied heavily on foreign captains and experts. Several countries have since significantly expanded their domestic fishing potential. Brazil still relies on Japanese captains, but native Brazilians are playing an increasingly important role, including positions as captains. Brazilians have also begun to shift from a multi-species fishery lightly harvesting swordfish to much more intense directed effort on the resource. Chilean companies have turned to Spanish companies for technical assistance, but have operated their longline fishery with much less foreign involvement than the Brazilians. Chilean longliners reported a huge catch increase in 1996, primarily in waters beyond the 200-mile limit. Costa Rica has deployed a small Pacific tuna longline fleet, some of which shifted to swordfish during 1996. Cuba has for years conducted a small longline fleet in the Atlantic and has reported a substantial swordfish catch increase in 1994-95

(primarily off West Africa), after several years of declining catches. The country's fishing industry was forced to make painful adjustments to the termination lucrative of Soviet subsidies.[6] Ecuador has deployed a wide range of artisanal and commercial tuna vessels which shifted some effort to swordfish in 1996. Mexico has a small tuna longline fleet in the Gulf of Mexico/Caribbean and is considering authorization of Pacific operations. Peru initiated coastal longlining for swordfish in 1997. Trinidad has deployed two large commercial longliners. Uruguayan domestic companies are expanding coastal operations to deliver high-quality fresh product. Venezuela conducts extensive longline operations for swordfish, tuna, and shark. Various Caribbean island countries have expanded artisanal operations. Developments in these and other countries illustrate the growing domestic technical competence and harvest capability in the region.

The outlook for expanded Latin American swordfish catches appears limited, despite the growing capability in the region. Incomplete information on stock structure and status make assessments difficult, but it appears that stocks off Latin America can not support greatly increased effort. More is known about the Atlantic than the southeastern Pacific, but factors such as declining catches, smaller fish, and increasingly distant voyages all point to heavily fished stocks. Some encouraging news was reported in 1996. The Chilean catch increased after 5 years of stead declines. Costa Rica, Ecuador, and Uruguay also reported catch increases in 1996. The overall pattern since 1991 has been falling catches. The 1996 increases reported in Chile, Costa Rica, Ecuador, and Uruguay all appear to be the expansion of the fishery onto new grounds or the acquisition of new vessels. The ability of the fishermen to achieve further increases or even maintain catch levels is yet to be determined. One important 1997 development was the initiation of swordfish fishing off Peru. While only a few boats are involved, based on historical records, Peru may have significant unutilized resource.

While Latin American fishermen may be able to report limited catch increases, this may not mean a significant net increase in swordfish harvests. The movement to offshore grounds by Latin American fishermen (Chile, Cuba, Ecuador, and Costa Rican) may mean that the Latin American fishermen are simply catching fish that were previously harvested by distant-water fishermen (Span, Japan, Taiwan and others). In two instances, Latin American fishermen (Chile and Cuba) are conducting distant water fisheries with swordfish catches in 1995 of about 1,000 tons. Even expanded coastal fishing (Brazil, Peru, and Uruguay), given the highly migratory character of the fish, may reduce the offshore distant-water catch.

A variety of factors could affect swordfish catches off Latin America beyond the capacity of Latin American fishermen to open new grounds or compete effectively with distant-water fishermen. Fluctuations in the swordfish stocks themselves will obviously affect regional catch levels.

Management: The success of management efforts will greatly affect future catches. Several countries have implemented national management schemes. Chile has the most extensive management scheme which includes the traditional regulations limiting fishing effort. The regulatory framework was expanded in 1997 with a new size requirement. The effectiveness of this and other regulatory programs remain to be seen and, in any case, given the highly migratory behavior of the fish, will be affected by international efforts. In Chile's case the outlook is not good as there is no international body managing Pacific swordfish for fisheries conducted on offshore grounds. ICCAT is attempting to manage Atlantic swordfish, but the ability of the countries involved to stop the decline in the fishery, let alone rebuild the stock, is yet to be determined.

Climate: Biologists have demonstrated that climatic events and long-term climatic trends affect fish the abundance and/or distribution of fish populations, including oceanic pelagics. The powerful El Niño developing in 1997 will have a yet to be determined impact on the catch and stocks off Latin America. Long -term climatic trends also can

affect swordfish. The impact off Latin America has not yet been determined, but some Chilean researchers have begun to assess the relationship.

Fodder species: Expanding fishing pressure on fodder species consumed directly or indirectly by swordfish could affect populations. The massive expansion of Chilean fishing on jack mackerel, for example, may have affected swordfish stocks. Peruvian observers, however, do not believe their anchovy fishery has a significant impact on swordfish. One common swordfish prey item is squid. This species is not a major target of Latin American fishermen, although there are small fisheries in Argentina, Venezuela, and other countries. Several Latin America countries (Argentina, Ecuador, the Falkland Islands, and Peru), however, have authorized extensive foreign operations for squid.

North America

Canada: Canadian fishermen are aware of the tremendous demand for swordfish that originates just south of their border with the United States. As long as U.S. importers are prepared to offer Canadian fishermen top dollar for their swordfish, often reaching markets in Boston within hours of being caught, these they will continue to seek access to swordfish in their waters. The key to future developments lies with the Canadian Government's ability to work with their fishermen and with other members of ICCAT to conserve and manage stocks of swordfish.

Before ICCAT was established, catch limits for Canadian fishermen were established by the Government of Canada. In 1994, however, ICCAT established a two-year agreement in which Canada agreed to catch 1,500 tons in 1995 and 1,400 tons in 1996. At the 1995 ICCAT meeting, a long-term sharing arrangement was worked out in which Canada accepted as its quota ten percent of the Total Allowable Catch (TAC) as determined by ICCAT. Thus, their percentage share will be the same each year until a new formula is established; the actual catch, by quantity, however, will likely fluctuate.

United States: With the implementation of limited access and the recent trend of decreasing quotas on the Atlantic, the demand for Pacific swordfish and imports may increase. Longlines are currently the dominant gear-type. This is unlikely to change as the use of driftnets is prohibited in state waters. The use of traditional gears, such as harpoons, will continue to decrease until the stocks are rebuilt.

Western Europe

There is no specific program for the development of swordfish fisheries in Western Europe. The fishery is driven by market demand and that demand is enormous. Key consumers are Spain and Italy where demand is growing and prices keep increasing. Portugal and Greece are the primary suppliers. Many of the Western European nations trade in swordfish, both importing and exporting. The demand for swordfish will push European fishermen to fish further and further away; Spain, Portugal, and Italy will be the key fishing nations pushing further afield, although France may join the move into the Indian and Pacific Oceans. The other nations of Europe will respond to this demand by increasing their harvest of swordfish and exporting their harvest to the primary EU markets.

World

The key to the future of swordfish will be cooperation among members of the world community to agree to conservation and management measures and to effect means of enforcing these measures. These efforts will hopefully allow the world's swordfish to recover and to be maintained at sustainable levels.

Photo 10.--Taiwan fishermen use the port of Montevideo, Uruguay to transship their catch of tuna and swordfish caught in the South Atlantic Ocean. Dennis Weidner

APPENDIX SECTION

APPENDIX A.

STATISTICAL TABLES

Table 1. WORLD--Total landings of swordfish, by ocean, 1985-95.

YEAR	ATLANTIC OCEAN			MEDITERRANEAN SEA	INDIAN OCEAN	PACIFIC OCEAN	TOTAL
	South	North	Sub-total				
	Metric Tons						
1985	9,521	14,348	23,869	15,228	2,999	17,018	59,114
1986	5,844	18,450	24,294	16,718	3,040	16,975	61,027
1987	5,952	20,224	26,176	18,288	4,114	19,198	67,776
1988	12,772	19,508	32,280	20,339	5,175	24,104	81,898
1989	16,786	17,246	34,032	17,761	3,861	23,203	78,857
1990	17,088	15,722	32,810	11,468	4,009	26,924	75,211
1991	13,337	14,709	28,046	10,759	4,730	23,298	66,833
1992	12,687	14,985	27,672	12,703	6,686	33,417	80,478
1993	15,421	16,756	32,177	10,968	10,475	34,268	87,888
1994	17,308	14,686	31,994	13,754	9,537	27,309	82,594
1995	19,900	16,408	36,308	1,639	13,516	31,198	82,661

Source: ICCAT, *Report of the Standing Committee on Research and Statistics (Madrid, October 28- November 1, 1996)*, Tenth Special Meeting of the Commission, San Sebastian, Spain, November 22-29, 1996, COM/96/25, (catch data for the Atlantic Ocean and Mediterranean Sea), FAO, *Yearbook of Fishery Statistics - Catches and landings, 1994*, Volume 78, Rome, Italy, 1996 (data for the Indian Ocean and Pacific Ocean for 1985-94), and FAO, unpublished report (preliminary data for 1995).

Table 2.--WORLD.List of countries that either caught and/or exported swordfish to the European Union or the United States in 1994, including countries that reported no swordfish catches.

No.	COUNTRY	Swordfish Catch	Total Fisheries Catch	Population (number of inhabitants)	National Product per Capita	TRADE IN SWORDFISH			
						MAJOR IMPORT MARKETS			
						European Union		U.S.A.	Total
						External suppliers	Intra-EU suppliers		
		Metric Tons		*Millions*	*US$1.00*	*Metric Tons*			
1	Japan	21,775	8,128,121	126	$20,200	20,200		129	20,329
2	Spain	14,702	1,290,000	39	$13,120		4,728	0	4,728
3	USA	9,957	5,939,339	264	$25,850	7			7
4	Italy	7,876	552,024	58	$17,180		50	4	54
5	Taiwan	6,764	1,415,834	22	$12,070	1,530		207	1,737
6	Chile	4,712	6,037,985	14	$7,010	18		2,228	2,246
7	Philippines	4,633	2,263,789	73	$2,310	43		10	53
8	Canada	2,230	1,171,614	28	$22,760	0		1,746	1,746
9	Brazil	1,759	780,000	161	$5,580	911		286	1,197
10	Greece	1,571	199,607	11	$8,870		312	0	312
11	Portugal	1,426	274,174	11	$10,190		938	8	946
12	Morocco	893	622,441	29	$3,060	716		0	716
13	Mexico	806	1,200,686	94	$7,900	0		440	440
14	Sri Lanka	640	220,900	18	$3,190	10		1	11
15	Algeria	562	90,460	29	$3,480	36		0	36
16	Venezuela	377	390,333	21	$8,670	33		142	175
17	Turkey	292	550,641	63	$4,910	0		0	0
18	Uruguay	260	118,819	3	$7,200	1,061		114	1,175
19	Tunisia	226	83,762	9	$4,250	2		0	2
20	Cuba	175	93,435	11	$1,260	55		0	55
21	Korea, ROK	162	2,648,977	46	$11,270	0		0	0
22	Cyprus	116	2,943	1	$12,500	19		0	19
23	France	95	830,000	58	$18,670		229	0	229
24	Malta	76	5,560	0	$10,760	54		0	54
25	Honduras	40	24,401	5	$1,820	788		0	788
26	Ecuador	33	330,720	11	$3,840	1		203	204
27	Benin	28	39,000	6	$1,260	0		0	0
28	Peru	19	8,450,600	24	$3,110	32		0	32
29	Liberia	14	7,782	3	$770	0		0	0
30	Argentina	14	930,592	34	$7,990	0		0	0
31	Australia	13	218,339	18	$20,720	ngl		1	1
32	Togo	8	16,988	4	$800	1		0	1
33	Grenada	7	2,093	1	$2,750	0		3	3
34	Tonga	5	2,481	0	$2,050	0		0	0
35	South Africa	4	563,228	45	$4,420	740		0	740
36	Singapore	0	11,654	3	$19,940	683		68	751

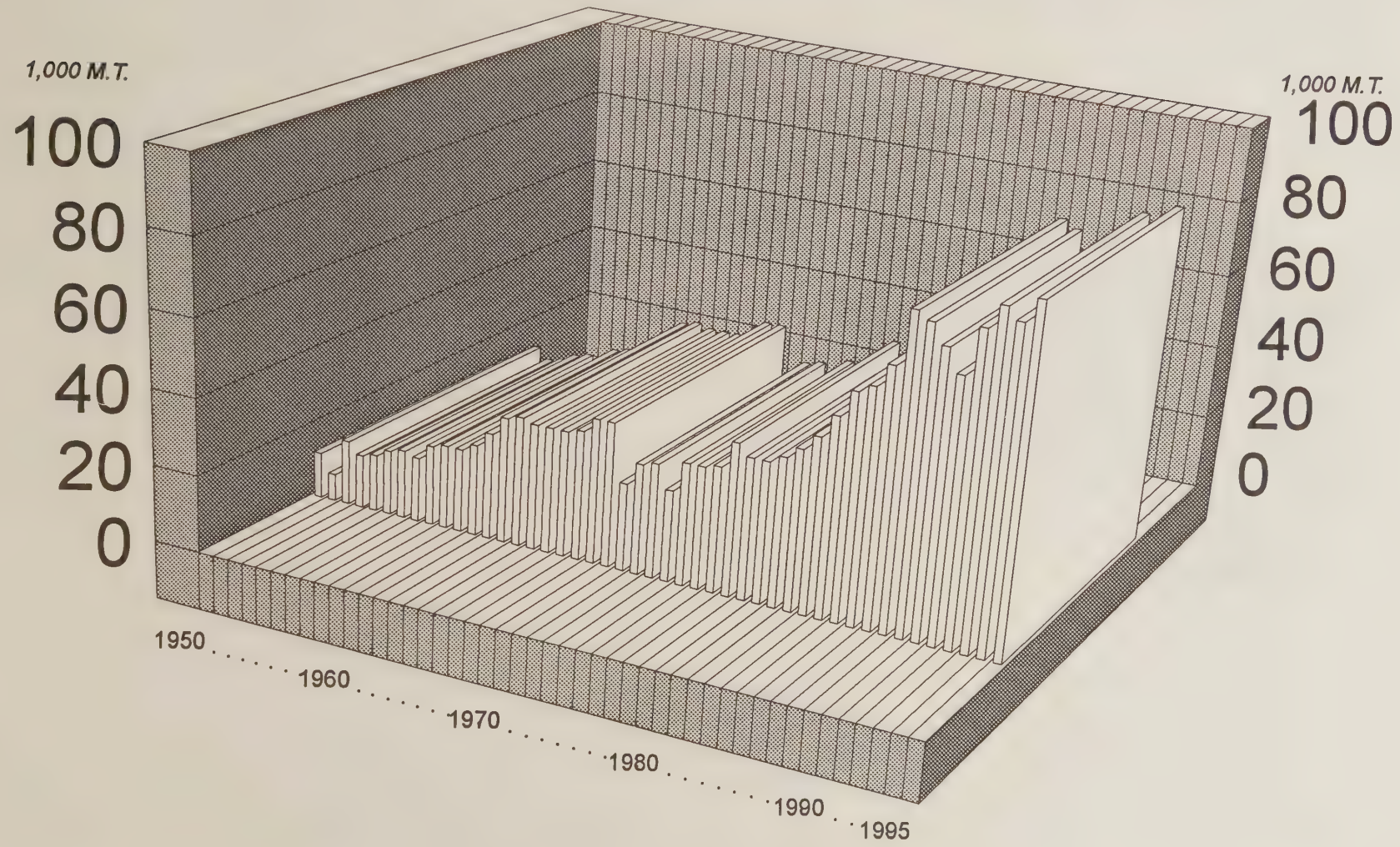
37	Mauritus	0	21,141	1	$8,600	531		0	531
38	Panama	0	158,216	3	$4,670	438		0	438
39	Sierra Leone	0	62,046	5	$1,000	227		0	227
40	Indonesia	0	3,637,700	204	$3,090	200		0	200
41	Senegal	0	377,676	9	$1,450	83		0	83
42	Reunion	0	2,733	1	$3,900	60		0	60
43	Netherlands Antilles	0	486,894	0	$10,000	48		0	48
44	Ghana	0	371,227	18	$1,310	40		0	40
45	Trinidad and Tobago	0	10,565	1	$11,280	32		187	219
46	China	0	17,567,907	1,203	$2,500	25		0	25
47	St.Vincent	0	1,781	0	$2,000	23		13	36
48	Malaysia	0	680,000	20	$8,650	20		0	20
49	Belize	0	2,129	0	$2,750	16		0	16
50	Namibia	0	329,790	2	$3,600	14		0	14
51	U.S. Pacific Islands	0	130	0	$10,500	14		0	14
52	French Polynesia	0	8,082	0	$7,000	7		0	7
53	Poland	0	423,029	39	$4,920	7		0	7
54	Oman	0	116,472	2	$10,020	6		0	6
55	India	0	4,324,231	937	$1,360	6		0	6
56	Thailand	0	3,348,149	60	$5,970	2		4	6
57	Uruguay	0	118,819	3	$7,200	0		44	44
58	New Zealand	0	470,383	3	$16,640	0		17	17
59	Costa Rica	0	17,650	3	$5,050	0		5	5
60	Antigua-Barbuda	0	2,400	0	$6,000	0		4	4
61	Barbados	0	2,852	0	$9,200	0		4	4
62	Fiji	0	31,399	1	$5,650	0		4	4
63	Colombia	0	146,407	36	$4,850	0		0	0
64	Belgium	0	36,433	10	$18,040	0		1	1
65	El Salvador	0	12,966	6	$1,710	0		1	1
66	Saudi Arabia	0	49,420	19	$9,510	0		1	1
67	Bahamas	0	10,051	0	$15,900	0		0	0
68	Faroe Islands	0	261,635	0	$14,000	ngl		0	0
69	Iceland	0	1,718,495	0	$17,250	ngl		4	4
70	Norway	0	2,561,771	4	$22,170	ngl		0	0
71	Côte d'Ivoire	0	70,174	15	$1,430	ngl		0	0
72	Seychelles	0	7,000	0	$6,000	ngl		0	0
	TOTAL:	82,270	82,957,075	3,949	$8,076	28,739	6,257	5,879	40,875

Source: Food and Agriculture Organization of the United Nations, *Yearbook of Fishery Statistics - Catches and landings, 1993*, Volume 76 Rome, 1995, pp. 333-334.

APPENDIX B.

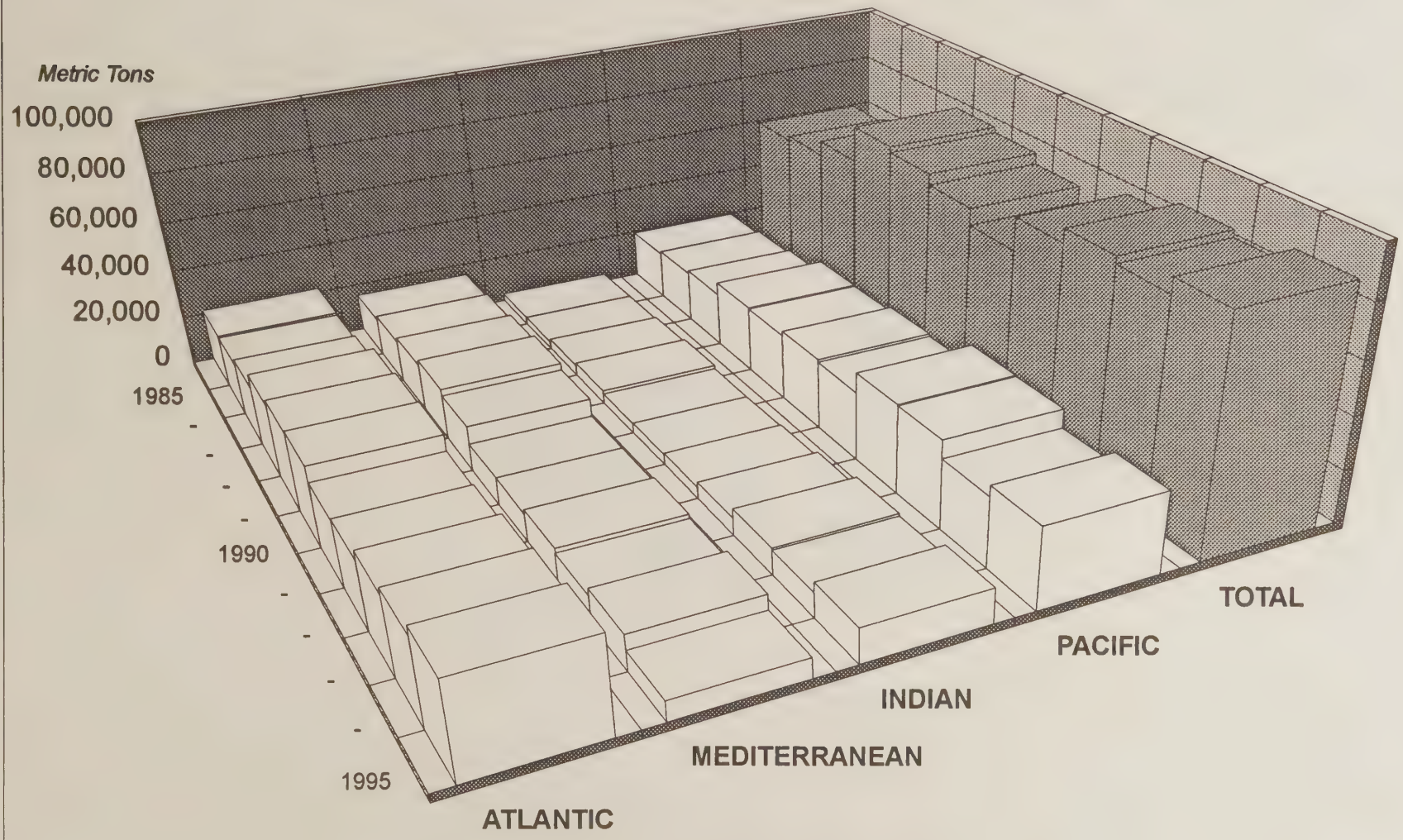
GRAPHICS

Fig. 1. WORLD--Catch of swordfish, 1950-95



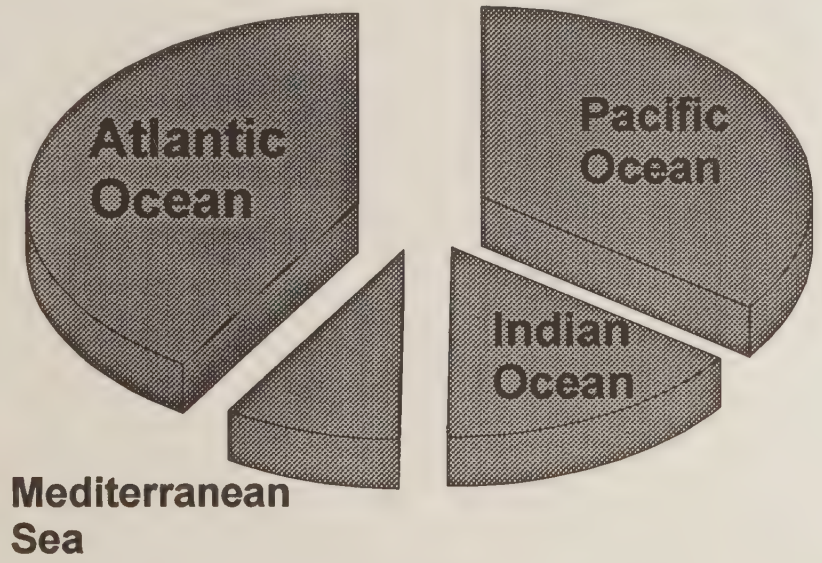
Source: FAO, *Yearbook of Fishery Statistics - Catches and landings, Rome, Italy*, various years.

Fig. 2 WORLD--Landings of swordfish, by ocean, 1985-95.



Source: FAO, *Yearbook of Fishery Statistics - Catches and landings, Rome, I*taly various years.

Fig. 3. WORLD--Total catch of swordfish, by ocean, 1995.



(by quantity)

APPENDIX C.

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APPENDIX D.

ENDNOTES

ENDNOTES

1. This estimate reflects the best numbers available when this report was prepared. The information, however, is NOT complete. Data for Japan -- the world's leading producer of swordfish -- is based on 1994 data and NOT 1995 data. This information was obtained from an *unpublished* report supplied by the Food and Agriculture Organization (FAO) of the United Nations (UN) in Rome, Italy. The FAO has since published it's *FAO Yearbook of Fishery Statistics - Catches and Landings, 1995*, Volume 80, Rome, 1997. That publication reports the total world harvest of swordfish in 1995 as 89,232 tons; this is 146 tons more than was initially reported.

2. These are based on FAO Fishing Areas. The International Commission for the Conservation of Atlantic Tunas (ICCAT) provides only two statistical reporting zones: the area above of 5° north and the section below 5° north.

3. This estimate reflects the best numbers available as this report was submitted for publication. Subsequent catch data has shown higher landings than previously reported.

4. Details on the foreign fishing regimes in Latin America are available in Dennis Weidner and David Hall, "Latin America," *World Fishing Fleets* (NMFS: Silver Spring, Maryland, 1993).

5. Chile permits foreign countries to transship their catch, but only if it is species of little interest to Chilean fishermen. As a result, the foreign fishermen operating in the Pacific cannot transship their swordfish catch. Despite this restriction, Chilean companies report sunstantial income from support services to foreign fishermen.

6. The major adjustment was the end of the Soviet oil subsidy. For details see the Cuban chapter in Weidner and Hall, *op. cit., p. 118.*